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Introduction

The intent of the International Symposium on Government Policies in Educational Technology was to provide an opportunity for policy-makers attending the World Congress in Educational Technology in Vancouver to discuss mutual concerns.

The symposium was held at the Empress Hotel in Victoria, B.C., in May 1986, and was hosted by the Honourable James J. Hewitt, Minister of Education, and the Honourable Russell G. Fraser, Minister of Post-Secondary Education, for the Province of British Columbia. A number of papers were presented during each session on a geographical basis. Following each group of papers, the presenters formed a panel to answer questions posed by delegates and engage in discussion.

This account of the proceedings contains the papers presented in each group, followed by the highlights of the discussion that took place following the presentations. The papers are presented here as they were received by the editor (with the exception of two or three, which were recorded in note form and are reproduced briefly). The discussions are as recorded by the editor during the conference.

If delegates have difficulty recognizing their questions or statements, the editor can only respond that the intent of the discussions are reproduced rather than verbatim reports. I apologize for any slippage that may have occurred.

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PRESENTATIONS

BRITISH COLUMBIA

James J. Hewitt, Minister of Education

Ladies and gentlemen, it gives me great pleasure to present the first paper to this distinguished gathering. This is, I'm sure, the largest such gathering in the field of education that has ever been seen in Victoria, and I'm sure the presentations and discussions will be interesting and informative.

The former Minister of Education, the Honourable Jack Heinrich, believed the World Congress on Education and Technology, which is to be held in Vancouver later this week, presented a golden opportunity for those of us who are responsible for making policy decisions about educational technology to talk about the factors involved in those decisions, what we have done and why, and where we intend to go from here.

History and Implications

When people hear the word "technology" they think of complex machinery and exotic devices doing incomprehensible things. In fact, "technology" simply means "how the work gets done" and can be very simple or very complex.

It has been argued that the last major advance in educational technology was the invention of the printing press, but I don't agree with that. I would argue that the printing press itself meant very little to education. The real change came about with the introduction of the textbook, some two centuries after the invention of the printing press, and I would further argue that the introduction of the textbook was the last major change in educational technology.

Certainly there have been changes in the technology of schooling since the advent of the textbook, including improved writing materials, films, radio, television, and audio and video recording, but those changes haven't produced startling differences in the way things are done in classrooms. Groups of students still watch teachers at the blackboard, and listen to teachers' explanations, and answer teachers' questions. They still take notes and study the text. The advanced technology made possible by electronics has not yet had much impact on schooling.

Given the history of technological innovation in education, that is not surprising. As I said, it took about 200 years after Gutenberg invented the printing press for books to become commonly accepted by educators. And that may be as it should be: teachers bear a large part of the responsibility of conveying our society's culture and wisdom from one generation to the next.

To indicate what might have happened if educators had been too eager to adopt new technologies, I delved back into magazines and newspapers of the past, to see what they thought the world would be like in the future. In 1920, it was predicted that the new wonders of the age — motion pictures and radio — would make school obsolete by 1940. Students would all stay home and listen to the radio, except when they went to a theatre to see the world spread out before them on the silver screen.

It was a good thing they didn't tear all the schools down, because by 1940 students were still going to school, and radio and motion pictures still weren't as useful as blackboards and textbooks, in the hands of capable teachers.

In 1950, Life magazine predicted that television and the telephone would make schools obsolete. Students would sit at home and watch their teacher on the television, and talk to him or her on the telephone. Again, it's a good thing they didn't tear down all the schools.

In 1960, it was interactive video. In 1970, it was computer hook-ups. In 1975, it was micro-computers that would make schools obsolete.

What We Have Done and Why

In British Columbia we have been conservative about developments in technology in education. We wanted to make sure the water was clear before we jumped in with both feet. We had no intention of waiting for 200 years before accepting worthwhile change, but we wanted to be sure that the change was worthwhile before diverting resources from proven methods and techniques to relatively untried ones.

In keeping with that approach, British Columbia was one of the first educational jurisdictions to engage in large-scale studies of the effects of micro-computers on education, and frankly the results were so unclear that it caused us to be cautious, at least as far as any large-scale investment by the Province was concerned. At the same time, to help overcome our rough geography and wide separation of communities, we developed the Knowledge Network, which broadcasts educational programs and series of courses over high-band and cable television throughout the Province. You will hear more about those developments later this morning.

The Province's efforts were conditioned by the fact that our resources were limited, and careful decisions had to be made about priorities in public spending.

It was decided to concentrate our efforts in the areas of curriculum and software analysis, two areas where Provincial leadership seemed especially important. The Ministry brought together the best computer teachers from across the Province and developed computer study courses for the senior grades; we commissioned one of the top university people in the Province to write a hand-book for elementary teachers; and we gave intensive in-service training to teachers who would be using these publications.

The Ministry also developed an effective computer software analysis process, again using the services of teachers throughout the Province, and circulated analyses of computer programs to all schools. Furthermore, individual school boards across the Province have also initiated projects, such as:

(1) The Nanaimo School District, further north on Vancouver Island, is one of two IBM test sites in Canada for WICAT Curriculum, a curriculum designed to offer instruction in core subjects throughout the elementary grades.

(2) Armstrong, a small school district in the Interior, has one of the first Apple Mac networks in use in Canada.

(3) Langley, a Lower Mainland district, was awarded a Mac Lab through the Steve Jobs Challenge, developed by the president of Apple Computers.

There are innovative software programs being developed in the Province and tested in our schools on a continuing basis.

At last count, there were over 12,000 micro-computers in schools in the Province, one for each 40 students.

The Ministry has been involved in a variety of projects, including taking a leading role in establishing the Council of Canadian Ministers of Education Software Analysis Clearinghouse, and acting in an advisory capacity to the IBM-University of Victoria Educational Software Design Project, headed by Dr. David Parnas.

But the Ministry has hesitated to push the acquisition and use of micro-computers at too great a pace, because there has been so much uncertainty about their effects on students, and indeed on schools generally.

Our schools, like everyone else's, aren't perfect, but they do a good job, and we must ensure that any decision we make improves sound educational practices.

However, the Government has decided that there is enough evidence to indicate that micro-computers may have a positive effect on the learning situation in schools. There is no question that for certain applications, such as school administration and training in areas such as word processing and business, they are not only useful but are becoming absolutely necessary. Even so, we are still not confident enough to simply mandate the introduction of relatively new technology, knowing that the full co-operation of all the people in the system will be needed if the introduction is to prove successful.

Last year the Ministry of Education conducted discussions across the Province with teachers, school boards, and the public, to talk about the direction education should take in the next few years. People told us that they thought there should be direction on a Province-wide basis, but there should also be discussion between the Province and school boards before action was taken.

The Government decided that in order to carry out the wishes of those respondents, school boards should be involved in all decisions from the start. The best way to accomplish that seemed to be not to establish a centrally-directed Provincial program, but to ask school boards what they thought would be most appropriate for the special circumstances of their districts.

We therefore created a fund for excellence in education, to which school districts are submitting proposals for innovative projects designed to improve education in the Province. There are four suggested categories for proposals, one of which relates to computer technology.

These proposals are examined by the staff of my Ministry who will give consideration to a variety of factors, including the recommendations of a committee of professionals established to suggest standards of performance suitable for educational micro-computers.

This committee, composed of three officials from the Ministry of Education and nominees from the B.C. Teachers' Federation, the Trustees' Association, universities and industry, will be recommending the most appropriate operating standards and requirements for micro-computers in education. Once they have reached agreement as to the nature of these standards, future proposals will be considered in the light of their recommendations. Should any of your jurisdictions already have such standards established, we would be pleased to exchange our thoughts with you.

The projects submitted to date are of various kinds. Some deal with new learning resources and equipment to meet the needs of new courses, but most proposals concern computers in one way or another.

From proposals received to date, there are 63 dealing with micro-computers. Included in these proposals are the following examples:

> One of the largest districts in the Province (Richmond) has presented a plan for a comprehensive project dealing with the core curriculum for both regular and special needs students, including computer-assisted instruction and administration and classroom management for all schools. They intend to have computer labs in all elementary schools, compact disk data bases especially for teaching critical thinking skills in science and social studies, and a strong component of access for the mentally handicapped and for students who are either in hospital or are homebound.
>
> A mid-size district (Saanich) has proposed a pilot project to examine one possible configuration of the classroom of the future. This project would tie in to major data bases in off-peak hours, so the cost would be lessened, and the students in the pilot school would have terminal access to these very powerful data bases.
>
> A small district in the Province (Armstrong) thinks that their needs will be best served by building on their current base of one micro-computer lab to their secondary school, aimed especially at the industrial and business education areas. Schools in such districts often have difficulty delivering a variety of courses to their small number of students, and this district feels that their proposal will help alleviate this situation.

Let Me Now Turn to the Future and the Challenges for Policy-makers

One thought that I would share with you was brought back from a recent European conference on computers in schools by Jack Fleming, our Assistant Deputy Minister of Schools. Most of the speakers at that conference, including some of the top educational researchers in Europe, were asking just what effect micro-computers might have on student learning. Will students learn to read better, faster, more easily? Or will they learn to read as the computer displays lines on the screen, rather than in a natural way?

What will computers do to the ambience of the classroom which seems to be so important for learning? What will they do to the teacher-student relationship? Before we throw away all our blackboards and textbooks, we'd better find the answers to these questions. This is one of the reasons we're still going to proceed with caution in the area of computers in schools. Again, our schools aren't perfect, but they work reasonably well. I would hate to see us trade our system for one that doesn't work as well, and spend vast amounts of taxpayers' money doing it.

One thing is clear. All that technology can do, from the simplest to the most complex, is to enhance the skills of the dedicated professional teacher. Research tells us that the greatest single difference in the success of students, apart from the students themselves, is the organization of instruction and the skill of the teacher.

Appropriate use of technology can help teachers; inappropriate use can hinder them. I want to make sure that British Columbia uses technology to help its teachers as much as possible in their efforts to enable our young people to meet the challenge of the 21st century. In that context, this symposium could not have come at a better time. British Columbia is undertaking what is, after all, a very significant project, and stands to gain considerable benefit from your experience, your opinions and your advice.

Ladies and gentlemen, before closing let me quote from a recent article written by a president of a college in the United States:

> "Before the computers that are now being urged on students can be properly used, literacy and the capacity to think must be taught. All students, no matter their future careers should learn to love language, to use it to reason, to view writing and critical reading as routes to expressing their ideas."

To add my personal comments — the ability to think, the ability to reason, the ability to communicate, is paramount in providing a sound foundation on which our youth can expand their knowledge in the fields of higher education, employment, the trades or the arts. Computer technology is available today, as are textbooks, to be used as tools by our professional teachers in conveying knowledge to those students who will be working in the very competitive world of the 21st century.

It is, therefore, our challenge and responsibility as policy makers to ensure our education systems are designed to take advantage of technology, but not to be captured by it.

Ladies and gentlemen, I would like to thank you for coming, and I'm sure that the next two days will give us all a sharper focus on the technical papers and presentations at the World Congress on Education and Technology in Vancouver. As policy makers we have a particularly important role to play, and we must be careful, when we are being introduced to technical issues, to remember to judge them in relation to their usefulness in helping students learn.

DISCUSSION

HAWAII

Who appointed the Committee you mentioned? How long have they worked together?

Answer

The Committee was appointed by myself, and is composed of Ministry of Education staff and representatives of teachers, trustees, and industry. They are to report to me in the near future concerning standards and levels of service.

MANITOBA

How do you balance autonomy of school boards with Ministry leadership?

Answer

That is a good question. Boards are elected and represent their constituents when talking to the Government. We usually manage to come to reasonable agreement with boards.

ZIMBABWE

We in the developing countries have a very real problem with technology. We do not have good schools with teachers and textbooks. Should we put our resources in that direction, or towards modern technology? Can we be assured modern technology will be effective?

Answer

We do not have an answer. Anyone? (No one was willing to recommend that developing countries put all their educational eggs in one technological basket.)

QUEBEC

How much is your special fund? How will it be distributed?

Answer

The fund is $600 million, over the next three years. Districts submit specific requests which are reviewed by a Ministry committee. The committee then makes recommendations to the Government. Submission may be for three year projects, to be monitored each year.

QUEBEC

Is there a limit to the funding? Does it include staff?

Answer

There is no limit, but we will keep some sort of equitable distribution in mind when approving allocations. The funds may be used for staff needed to implement a program, but not for staff that are on-going. We do not want to fund projects that have long-term staffing implications.

GHANA

We are concerned that technology may be moving faster than educational expertise. Can we be sure that changes are sound?

Answer

We are very unsure about technology in instruction, and we want to be cautious there, but we know our students have to deal with new technologies, and we have to provide some training.

NEW BRUNSWICK

We are fortunate to live in a country that can afford both a basic system and new technology. However, we do have a problem that many countries do not have, in that we have to educate many special needs students. Do your projects deal with that?

Answer

One proposal that has been approved has a major component for special education. I expect others will also be looking in that direction.

BRITISH COLUMBIA

Glen M. Farrell, President Knowledge Network

British Columbia is Canada's westernmost Province. It includes approximately 950,000 square kilometres, has a very mountainous and rugged geography, and its population, which is in excess of two million people, is concentrated in its extreme southwest corner in the metropolitan areas of the cities of Vancouver and Victoria. Approximately one-half of the population lives in this concentrated area with the other half scattered throughout the remainder of the Province in many small communities.

In order to ensure that people living in these smaller centres throughout the Province have access to educational opportunities, the Provincial Government, from a very early date, had to develop educational delivery systems which would ensure that these needs were met. As a result, a correspondence branch was established in the 1920s as a component part of the Provincial Ministry of Education. Through this branch, students were ensured access to the public school curriculum, thus permitting those who could not attend school in the conventional way to complete high school diplomas.

Over the years a major problem of access to post-secondary education developed in that the Province's three universities were established in the southwest corner of the Province in the major population centres. As a partial solution to this problem, and to further enhance the program opportunities in the career technical vocational training area, a network of regional colleges was established during the period between 1965 and 1975. As part of the offerings of these colleges a two-year university transfer program was developed thus making at least the first two years of a general university arts and science program more accessible to students in the non-metropolitan areas of the Province.

As a further step in making education broadly accessible to the people of British Columbia, the Province established an Open Learning Institute in 1978. The mandate of this institution was to provide a range of programs, including university degrees, technical, technical-vocational certificates and diplomas and adult basic education courses, entirely through distance education methods. The primary method used by the Institute is the combination of print materials coupled with local tutors.

Development of the Knowledge Network

The foregoing overview provides a context for the development of the Knowledge Network which was formally established in 1980. The mandate of the Knowledge Network can be described as follows:

— to provide a telecommunications delivery system for use by educational institutions in British Columbia;

— to collaborate with educational institutions in developing innovative ways to utilize the telecommunications system for educational purposes;

— to provide a program of general education for the public of British Columbia.

The initial activity which eventually led to the creation of the Knowledge Network began in 1977 when the Canadian Government encouraged the experimental use of its satellite technology for educational purposes. The Provincial Government arranged to have one of the experimental projects which involved the use of the Hermes satellite. Several universities and colleges were invited to try offering short courses to five selected locations throughout the Province. This first experiment worked so successfully that the Province subsequently applied for a longer-term pilot project which extended over a two-year period and involved more educational institutions providing longer-term programming to twelve sites throughout the Province. This pilot project utilized the Anik C satellite. It clearly demonstrated that the technology could be used very effectively in combination with prepared print materials which were mailed to students and, occasionally, in combination

with the use of the telephone system whereby students could raise questions with an instructor both during and after the completion of the television component of the program.

As a result of the successful demonstration and subsequent pilot projects, the Province formally established the Knowledge Network as an ongoing component of the British Columbia educational system in 1980 and began to involve the local cable licensee as part of the overall delivery network. This latter development was an important one in the sense that students were now able to access educational programming in their own homes rather than having to go to a central community location in order to receive the television program. Figure 1 illustrates the architecture of the delivery system as it now exists. Because approximately 85% of all households in British Columbia are connected to a cable system, access to the programming offered on the Knowledge Network is very widely accessible. Many of the more rural communities which do not have a community coaxial system, have established a low-power broadcast transmitter to serve their local area. Through this network programming is now available in more than 250 communities throughout British Columbia and is watched each week by approximately 500,000 people.

Development of Open Learning Systems

Before going on to describe the program activities of the Knowledge Network and the way in which it works with the rest of the educational system, it is useful to step back and examine in more general terms how systems of open learning are evolving in other parts of Canada, and indeed throughout the world.

Figure 2 provides a simplified way of illustrating the evolution of open learning delivery systems as they have emerged from traditional models of education. These traditional models referred in Quadrant A of the diagram, can be characterized as being primarily dependent on the physical presence of a teacher, with the instruction conducted in a fixed physical facility such as a school or on an institutional campus.

The type of learning system typified in Quadrant B is again primarily dependent on the physical presence of an instructor; however, as transportation systems developed, so did the capability for teachers to meet students at locations remote from the "home campus". Indeed the early history of extension programs at many North American universities is replete with program examples which used the itinerant teacher model, with the instruction occurring at the community level utilizing a variety of local facilities.

Distance education as described in Quadrant C is defined as learning which is not dependent on the physical presence of an instructor and which does not occur at a fixed location. The earliest, and still most persuasive example, is correspondence education. More recent examples include the use of telecommunication technology such as radio, television and computer formats delivered through both land-based and satellite networks.

As learning materials are developed for Quadrant C-type learning systems, it is being recognized that they are, for the most part, equally applicable to the needs of learners studying in a conventional school or campus environment. The effect, particularly as we look to the future, is that the educational materials developed will be used to meet learning needs in a variety of contexts. The geographical location of the learner will become a less important consideration because of the telecommunication networks that are emerging.

Program Activities

In general terms, the program activities in which the Knowledge Network is involved are primarily those described in Quadrant C of the Figure 2 diagram; however increasingly the Network is involved in the provision of materials for use within the classrooms of traditional educational institutions.

Figure 3 provides a more precise description of the components of the Knowledge Network's educational program activities. In each of these areas the role of the Knowledge Network is somewhat different. For example, in the area of university programs the Knowledge Network participates in a planning council which involves all of the universities in the Province and through which the needs for university-level programming are assessed and priorities are established. Funds are then allocated to the universities to develop the appropriate programs and the Knowledge Network assists in the delivery by building in the video component of the course work to its regular daily schedule.

In the technical vocational program area, which involves working with the college system in the Province, the Network also plays a role in the stage of identifying program priorities and then assists the colleges in either identifying and acquiring program materials which may have been developed elsewhere, or if materials are not available, working with the colleges to produce the programs using the facilities of the Network.

The services provided by the Knowledge Network to the public school system in the Province are probably the least well developed. At this point the Network does have a school broadcast component to its schedule whereby video materials are carried on the Network and distributed to many schools for use by teachers in their classrooms. Developmental activities now underway will likely result in the Network being able to provide computer-based program materials as well.

Approximately 40% of the yearly program schedule of the Knowledge Network consists of general interest programming within the open sector category. This type of programming consists of materials that are acquired for broadcast by the Network. Decisions as to what to acquire are based on feedback received throughout the year from viewers as well as from educational institutions throughout the Province. In addition, the Network maintains a regular liaison with various Ministries of the Provincial Governmment in order to determine ways in which their various educational program activities can be facilitated through the use of the Network. In a similar way the Network maintains liaison with various community groups at both the local and Provincial level in order to animate their use of the telecommunications delivery system.

Figure 4 provides a different perspective on the program activity of the Knowledge Network. The model of the pyramid serves to illustrate the comparative relationships among the various types of program activities in terms of student participation and viewership. Several comments are worth noting as one moves from the general interest type of programming at the base of the pyramid to the post-degree programming illustrated at the apex:

— the number of actual students participating decreases;

— the need for sophisticated attention to instructional design in the development of course materials increases;

— the need for other instructional modes besides television such as print, audio, personal tutoring and computer-assisted methods increases;

— the degree of involvement of, and direction from, formal eductional institutions increases;

— the need for high-cost production values for learning materials decreases.

Concluding Comments

The rapid development of telecommunication technology, often referred to as telematics, is having and will continue to have, a profound influence on education.

— universal access to all forms and levels of education is becoming a reality;

— the delivery costs of education will decrease — thus permitting a reallocation of resources to other functions such as the development of basic skills which typically require more involvement of face-to-face instruction;

— the nature of the learning process is changing with the result that people need to develop new skills to be able to learn effectively through these new delivery systems. This is particularly true for adults;

— the curriculum itself is changing in the sense that former priorities as to what is important for people to know at any particular age is being re-examined;

— the role of public education institutions, the traditional providers of education, is changing, and for some types of education such as work-related skills, is diminishing as the private sector becomes more involved in this area;

— new types of public education institutions are rapidly emerging as a societal response to these changes and because the traditional institutions cannot, will not, adopt quickly enough. Such new institutions are particularly characterized by their use of telecommunication technology and open learning systems which permit students to combine learning and living throughout the life span.

FIGURE 1

THE KNOWLEDGE NETWORK

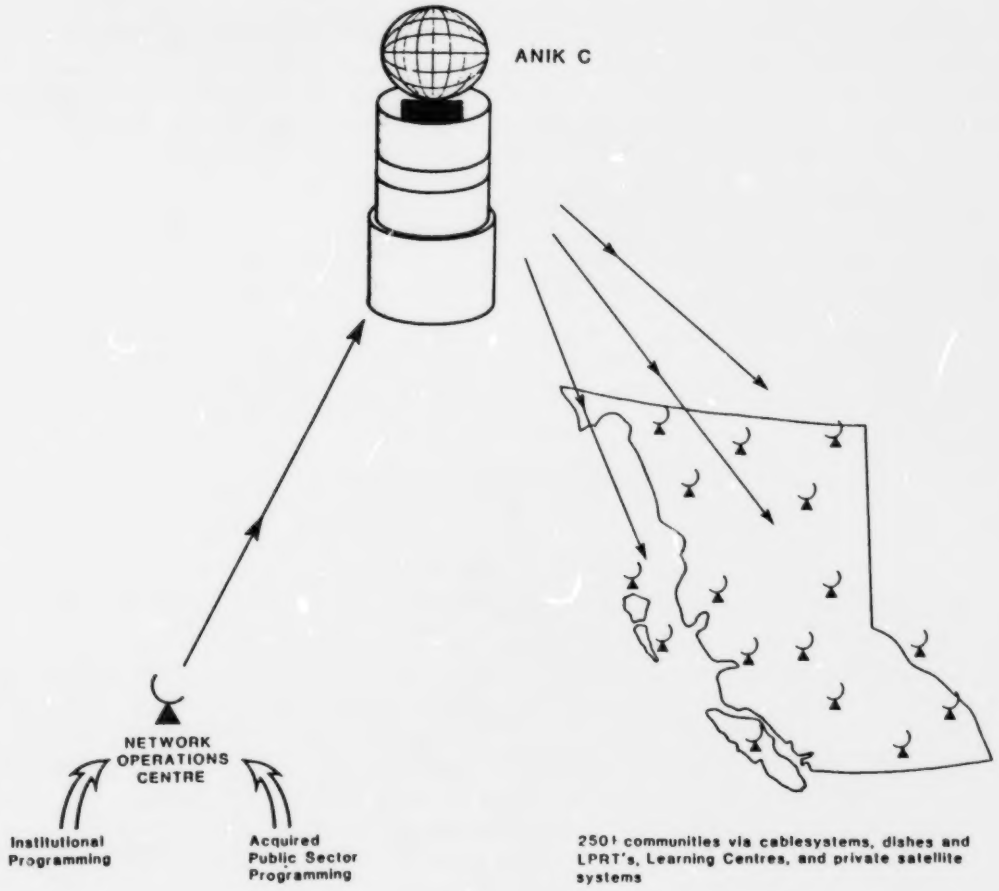

ANIK C
NETWORK OPERATIONS CENTRE
Institutional Programming
Acquired Public Sector Programming
2501 communities via cablesystems, dishes and LPRT's, Learning Centres, and private satellite systems

FIGURE 2

The Evolution of Open Learning Systems

Teacher Dependent

A. Traditional	B. Itinerant
Location Fixed	Location Free
D. Closed Circuit	C. Distance Education

Teacher Independent

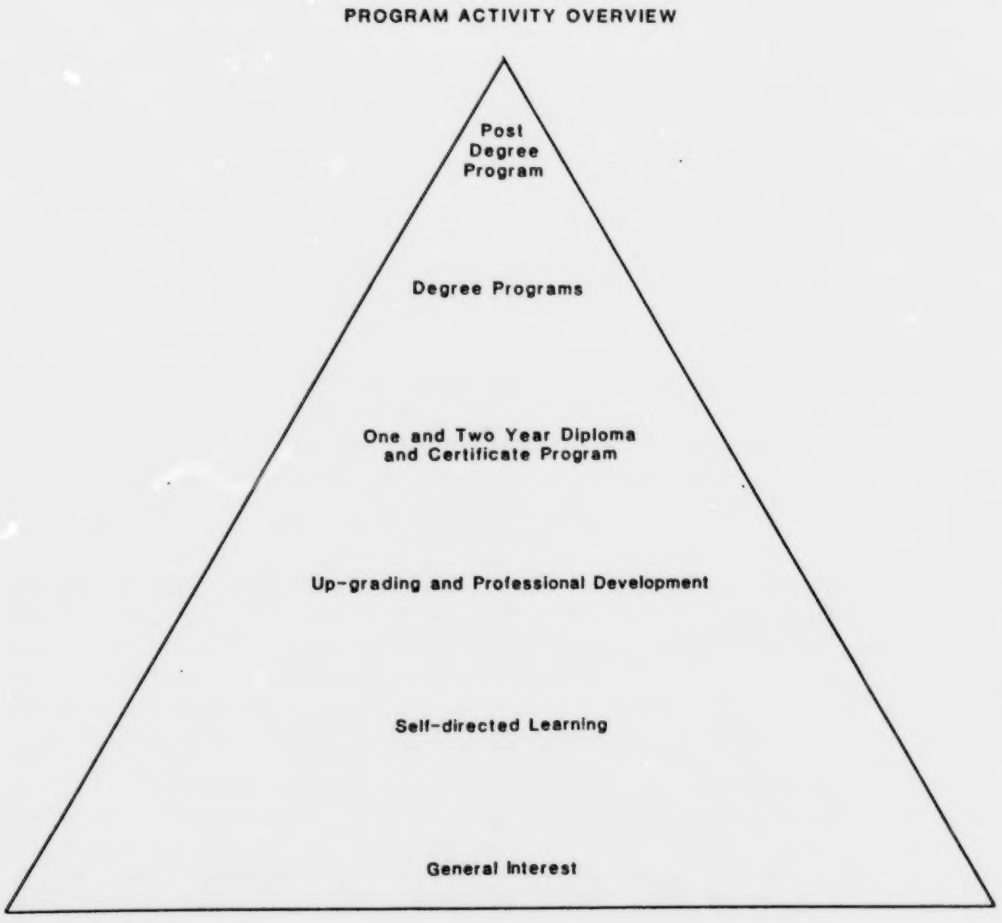
FIGURE 3

Knowledge Network Program Activities

Universities	Technical/Vocational (Colleges)	Schools	Open Sector		
			Government	Community Groups	General Interest
Degrees	Diploma	Curriculum	Educational Programs	Educational Programs	Health Sciences Technology Arts Children
Diplomas	Certificates	Support Materials — Video — Computer-based (developing)			
Certificates	Language Training				
Continuing Professional Education	Job Skill Training				

FIGURE 4

Program Activity Overview



DISCUSSION

NEWFOUNDLAND

Thank-you for the kind words about our use of technology. We have made extensive use of teleconferencing, especially at the Post-Secondary level. We have found telewriting very useful.

SINGAPORE

Do you have any opinion as to the relative cost-effectiveness of satellites vs. video-tape?

Answer

Video-tape is effective for small numbers. As student numbers go up, satellite transmissions become cost-effective. The program with satellite is the initial cost. You have to have a broad base. In our case, it costs about $1,000 per student per course for university level courses. Students can obtain a degree at a total cost of about $20,000 — of which the students pay part.

GHANA

Again, we are impressed with your technology, but we are grappling with the basics. How good is your system for vocational/technical training?

Answer

At the moment, we must have mixed delivery. Distance learning supplements hands-on learning. You cannot teach welding by distance at the moment.

ZIMBABWE

We do not have enough teachers for all our young people. Can we teach them in this way?

Answer

I do not know. We provide supplementary material for school classrooms, but it is only supplementary. The Province has a well developed correspondence program, which we are in the process of expanding. Research is very thin in the area of distance learning for young students. Older students are well-motivated, but we do not know whether young children can gain their education by distance learning.

HAWAII

Do you have any class size research?

Answer

No. However, Stanford University did some research on the question. They found that in Post-Graduate courses students did not have any questions, so classes could be any size. The students just wanted the information. However, as age and level of the material declines, more questions are asked, and more interaction is needed.

ONTARIO

Douglas A. Penny, Assistant Deputy Minister, Ministry of Education

The Ontario Educational Technology Program

I Major Phases and Steps Taken

Activity in Ontario related to educational technology falls into four phases.

1. Pre 1979 — Infrastructure Development
2. 1979–81 — Strategic Analysis and Planning
3. 1981–85 — Initiation of Pilot Programs
4. 1986 — Program Reorientation, Expansion and Active Implementation.

1. Pre 1979 — Infrastructure Development

- Intellectual infrastructure developed through:
  - — enlargement of universities and creation of computer science and electronic engineering programs;
  - — creation of Colleges of Applied Arts and Technology and capacity to meet technical support needs;
  - — emergence at University of Waterloo of a special focus on computer science;
  - — creation at the Ontario Institute for Studies in Education of a long-range "Individualization Project" and a centre for computer applications.
- Development by OISE of the CAN Courseware Authoring System and development of courseware and a networked delivery system in some of the colleges in conjunction with OISE.
- In the elementary-secondary sector:
  - — interest focused on formation of TVO which grew out of the Ministry of Education's curriculum branch;
  - — monitoring of work on CBL and some research;
  - — development of Computer Science programs for secondary schools;
  - — provision of administrative data processing services to smaller school boards.

2. 1979–81 — Strategic Analysis and Planning

- Formation of a "Planning and Policy Analysis Division" and institution of a formal strategic planning process leading to a growing appreciation of the strategic importance of the new information technology, as outlined in Sections I and II.
- Stepped-up monitoring of developments, especially the emergence of the micro-computer.
- Development of strategic appreciation of potential value and need for the utilization of the new information technology in education and training (as per Appendix).
- Realization that improved technology and lowered costs made general application feasible.
- Decision to formulate a plan for general application to education and training in Ontario.
- Goals and a general approach were established as follows:
  - — first, to ensure that the education and training systems are capable of providing the knowledge, skills and attitudes about the new information technologies that are needed in a world in which they are the principal tools;

— second, to make the best possible use of the new technologies in improving learning;

— third, to ensure that these goals are mutually supportive.

The Ministry's general approach to achieving these goals would be based on:

1. Encouraging and facilitating the use of computers and the new information technology generally in all subjects and at all levels in the system wherever they can improve student learning and assist the student's intellectual and creative development.
2. Achieving general understanding, acceptance and "comfort" with the new technology, not through special courses, but by having students from the earliest grades use computers in a natural way as personal learning tools integral to the normal instructional process.
3. Making sure that opportunities are widely available in the secondary schools, Colleges of Applied Arts and Technology and universities to develop the special knowledge and skills needed to develop, use and maintain the new key technologies.

- The plan would:
  - — focus initially on the elementary/secondary sector and provide direct support to the Ministry's curriculum policy;
  - — look for synergy wherever possible with the more autonomous post-secondary sectors;
  - — be based on the intellectual infrastructure established in the universities and colleges and OISE:
  - — be developed co-operatively with the Canadian micro-electronics and software industries and combine educational and industrial development objectives.

The more specific elements would include:

— creation of a body of software of high educational quality directly relevant to Ontario's curriculum objectives, reflecting a positive sense of Canadian identity and supporting teaching/learning methods advocated by Ministry policy,

— definition of "Functional Requirements" to create a common level of functionality in second generation micro-computer systems which would support software of these characteristics and provide a base for future software development and for movement towards complete software portability;

— Canadian procurement of educational software centrally through the Ministry to assist development of an educational sector in the software industry as a basis for:
  - — maximum cost advantage in licensing software for Ontario schools;
  - — maximum adherence to "exemplary" standards for educational software;
  - — assurance of a domestic source of supply for future needs;
  - — developing expertise in the industry for success in international marketing.

— Formation of a Canadian company corporately focused on education to work co-operatively with Ministry to design and manufacture the first micro-computer system meeting the new functional requirements and to work towards a software environment for education, to ensure:
  - — possibility of domestic procurement of some part of the very large hardware requirements of Ontario schools;
  - — availability of hardware and systems software illustrating the Ministry's educational objectives;
  - — possibility of industrial development through export;
  - — leverage with other (multinational) hardware vendors.

— Development of an approach to licensing to provide maximum legal protection and broadest possible access to the new software.

— Development, in co-operation with TVO, of a software distribution system to Ontario schools positioned so as to take advantage of new developments in telematics as they became available and cost effective.

— Continued development of the "Educational Computing Network of Ontario" to provide not only administrative data processing services to Ontario schools boards but a general data communication network for information interchange, software, etc.

— Evolution of the Ministry's correspondence education school into a centre for the development of computer-based materials for distance education and their delivery by electronic means.

3. 1981–85 — Initiation of Pilot Programs

The first programs to give effect to these plans were initiated in 1981.

A few cardinal points:

Mar. 1981 — Ministries of Education and Industry and Trade agree with Canadian Advanced Technology Association to identify functional requirements for a micro-computer system for education and to work towards creating a Canadian company to build it.

Oct. 1981 — Private company formed (CEMCorp).

Mar. 1982 — First software development projects initiated (for existing first generation 8-bit machines).

Mar. 1983 — "Functional Requirements — Stage I" finalized and released.

— $10 million "guaranteed" purchase from CEMCorp entered into as a focus of market entry assistance to ensure development and manufacture of first system to meet the new functional requirements (ICON).

— Policy confirmed of providing school boards with incentive grants to aid purchase of systems meeting the functional requirements.

Dec. 1983 — Decision to form an "Education Technology Development Division" to give focused leadership in the area of educational technology.

Jan. 1984 — Software development program initiated for the new 16-bit networked systems meeting the functional requirements.

May 1984 — First production model "ICONs" delivered to schools.

— Software distribution service contracted by the Ministry from TVOntario begins operation.

Oct. 1984 — CEMCorp and Burroughs announce joint venture leading to Canada-wide and international marketing and support by Burroughs.

Oct. 1985 — IBM develops a system meeting the Stage I functional requirements.

Dec. 1985 — Agreement with IBM, Burroughs and Meridian (CEMCorp parent) to implement a common portable environment for educational software.

As of year-end, 1985:

— Fifty Ministry-commissioned software items available for systems meeting Ministry requirements.

— Software development program underway with over 100 contracts in progress involving 12 public institutions and 60 private companies in five provinces.

— 11,500 micro-computers meeting functional requirements, in Ontario schools and about 600 file-servers.

4. 1986: Program Reorientation, Expansion and Active Implementation

- The change of government in Ontario in the spring of 1985 led to a re-appraisal of many programs initiated by the previous government, including those in educational technology.
- By year-end this re-appraisal was substantially complete leading to the following:
  - — the strategic appreciation was valid and justified the continued development of an educational technology program;
  - — the pilot programs initiated in the previous phase should be maintained but broadened in scope to provide:
    - — support for the effective classroom utilization of a broader range of existing technologies;
    - — broader consultation;
    - — stepped up implementation services;
    - — greater emphasis on the software program;

— accelerated development of a "common environment" for software development to facilitate entry of a wider range of hardware vendors;
— regular review of programs and strategic objectives in light of the rapidly evolving technology.

— final decisions about the nature and scale of the future programs are now being made;

— net effect will be to move from the pilot program stage to one of active implementation.

II Some Key Decisions and the Policy Development Process

- Strategic appreciation was a direct product of the Ministry's formal strategic planning process.
- Operational planning and policy was developed by assigned Ministry staff with periodic ratification of key decisions and funding allocations at the Ministerial and Cabinet level.
- Advice on educational aspects was solicited through the work of a major "Advisory Committee on Educational Technology" which operated over the period.
- Advice on industrial aspects was provided by the Ministry of Industry, Trade and Technology and the Canadian Advanced Technology Association.
- Technical advice was obtained through a "Technical Advisory Committee" and through numerous commissioned studies and reports from experts in the university and consulting communities.
- Critical decisions included:
  - — insistence on Ministry curriculum policy and objectives as prime determinant of nature of software and system for its delivery;
  - — commissioning software development rather than awaiting availability on open market;
  - — insistence on effective instructional design, effective use of the technology and formative evaluation during development;
  - — development in private rather than public sector;
  - — insistence on development in Canada;
  - — parallel development in English and French;
  - — central procurement rather than acquisition by individual school boards;
  - — Province-wide licensing wherever possible;
  - — provision of support for the community of entrepreneurial software developers;
  - — development of functional requirements derived from educational consideration for a new category of micro-computers based on 16-bit networked systems, rather than selecting from existing systems;
  - — catalyzing the formation of a new company to develop and manufacture the first example of the new type of system;
  - — provision of additional grants to help school boards acquire the new system;
  - — open market for all vendors with systems meeting the requirements;
  - — use of the most portable possible systems software and development of a single portable environment for software development;
  - — creating an organizational focus (Education Technology Development Division).
- Some things we wouldn't do if we started over again:
  - — allow "generically similar" types of operating systems rather than designating a particular system;
  - — delaying focused implementation work with school boards.
- Obviously the jury is still out on the validity of the overall approach. If it works it will have been the right thing; if it doesn't it will not have been.

ALBERTA

Reno A. Bosetti, Deputy Minister, Department of Education

Introduction

Not so long ago, pioneers in Canada took up the challenge of creating a life for themselves in the Canadian hinterland. They built homes, towns, cities, schools, and hopes for their children. These pioneers would be amazed at the changes in the society they founded that have occurred through the technological innovations of the last 50 years; not least those in education. The original one-room schoolhouse of the Canadian west has come a long way and is now no stranger to broadcasting, satellite television, audio-visual materials of all sorts, science laboratories, and a proliferation of computers. Certainly technology is changing our very conception and understanding of the ways in which instruction and learning takes place.

Today, we stand on the threshold of a new era of opportunities. Our challenge is to harness the potential of technology and computers to prepare the children of today for tomorrow's world. In Alberta, we welcome the opportunity to participate in this first International Symposium and the World Congress on Technology and Education that follows, to share our experiences and to learn from the experiences of others.

Historical Perspective

In the wake of research studies and pilot projects which explored the ways in which computer technology could enhance instruction and student achievement, an Electronic Education Exposition was held on October 23, 1981. This exposition signaled the first formal involvement of the Government of Alberta in the introduction of these new technologies to education.

In a speech at this exposition, the Honourable David King, then Minister of Education for Alberta, stressed the importance of computer literacy for Alberta students. He emphasized the need for graduates from the school system to be knowledgeable about computers and the need for them to be confident in applying this technology. Mr. King commented that young Albertans would need to master computers as tools which could help them to deal with a changing work environment, to manage information, to help achieve personal goals and to help enrich the life of their communities. He also noted that, in order to prepare students, schools would need (1) hardware, (2) computerized learning materials, (3) trained and interested teachers, and (4) community, political, and financial support for such school-based programs.

Mr. King announced nine actions that the Government of Alberta would take to advance the use of computers in Alberta schools:

(1) the establishment of an office of educational technology. This later became known as the Computer Technology Project of Alberta Education;

(2) the preparation of Computer Literacy Curricula for elementary, junior-high, and senior-high schools;

(3) the establishment of a basic hardware standard;

(4) the purchase, for resale to schools at a reduced price, of 1000 Bell and Howell modified Apple II computers complete with two disk drives, colour monitors, printers and some software packages;

(5) the development of an orientation and inservice program for teachers and administrators;

(6) the establishment of a computer learning materials clearinghouse to find, acquire and evaluate the various computer programs written for educational purposes;

(7) the establishment of a research and evaluation program, in part to determine what effects the introduction of technology can have on instructional and learning processes;

(8) the pilot-testing of computer network learning;

(9) the establishment of a Ministerial Task Force to investigate the future applications of technology to the Alberta educational system.

In June 1983, the Minister's Task Force on Computers in Schools presented a report containing 48 recommendations which charted a 3–5 year course for the use of computers in provincial classrooms. These

recommendations spanned the areas of hardware, software, inservice, curriculum, networking and school facilities.

To date, approximately 40 of these recommendations have been implemented partially or completely and, together with the initiatives outlined above, have resulted in significant achievements in technology and education in Alberta.

Developments in the Last Three Years and Current Situation

Hardware

On May 30, 1984 the Government of Alberta announced the availability of approximately $31.5 million in matching grants to school boards for the acquisition of computer hardware. A 1985 survey, conducted by Dr. Petruk of the University of Alberta on behalf of Alberta Education, shows that there has been a phenomenal growth in the number of micro-computers in Alberta schools. At the end of 1985 there were 24,267 micro-computers in schools compared with an estimate of 256 in 1981.

This same survey identified by brand the numbers of computers in Alberta schools. It indicates that Apple computers maintain a strong share of the educational computing market; IBM shows strong gains; and Commodore, Radio Shack and others seem to be losing ground. Further analysis shows that IBM computers are being used primarily in Business Education and school administration while Apple computers are being used for other educational applications such as computer assisted instruction and computer literacy.

Software

The Computer Technology Project began work in 1982 on a number of activities. The Project negotiated a provincial license for the acquisition and use of micro-computer programs produced by the Minnesota Educational Computing Consortium (MECC). Currently, the Alberta collection of MECC materials includes more than 160 floppy disks of micro-computer programs. ACCESS Alberta has installed a disk duplicating machine, and now distributes these disks and print materials throughout the Province.

A Clearinghouse for the evaluation of computer courseware was established within the Computer Technology Project. The Clearinghouse has developed a three-stage process for evaluating, approving and recommending computer courseware for use in Alberta schools. A standard set of evaluation criteria, developed by Clearinghouse staff, is used when evaluating materials designed for computer assisted instruction. The Council of Ministers of Education, Canada (CMEC), in establishing a national Database for Educational Software, also have established a standard set of evaluation criteria that essentially follows the Alberta model. An outline of the evaluation process used in Alberta follows.

First, materials are given an initial screening by Clearinghouse staff. Second, if found appropriate the materials are then evaluated independently by three teachers. These teachers, who have been trained and tested in evaluation techniques, use the evaluation instruments developed by Alberta Education and summarize their findings in individual reports. The reports are synthesized and appropriate materials are forwarded to Alberta Education's Program Development Division for final assessment. The Curriculum Branch (a branch within the Program Development Division) classifies courseware according to three designations for learning resources:

(1) *Basic Learning Resources* are those learning resources authorized by the Minister as being the most appropriate for meeting the majority of goals and objectives for courses, or for substantial components of courses;

(2) *Recommended Learning Resources* are those learning resources authorized by Alberta Education as they complement Basic Learning Resources by making an important contribution to one or more of the major goals of courses;

(3) *Supplementary Learning Resources* are those learning resources authorized by Alberta Education to support courses of study by reinforcing or enriching the learning experience.

Products identified as "Basic" or "Recommended" learning resources are acquired and provided at discount prices to Alberta schools through the Alberta Education School Book Branch. To date 3,328 packages have been processed. One package has been identified as "Basic," 29 as "Recommended" and 109 as "Supplementary." In addition, about 490 packages are currently under review.

It may be interesting to note the fact that only one package has been identified as a "Basic" learning resource. There has been a tendency to evaluate each courseware package in isolation from others. Moreover, the definition of "Basic Learning Resource" means that such a resource must cover a major portion of the curriculum. These two factors and the somewhat limited capacity of micro-computers currently in use to accommodate courseware that covers a majority of a curriculum makes it unlikely that much courseware would

ever be identified as a "Basic" Learning Resource. Alberta Education is considering a process whereby several courseware packages in combination, perhaps from different suppliers, might constitute a "Basic" learning resource.

Inservice

During 1982 and 1983 the Computer Technology Project provided over 300 workshops for educators on the uses of computers in education. In recognition of educator's needs for inservice in this and other areas, the Government of Alberta announced, in Spring 1984, an annual teacher inservice grant of $9 per student. For 1985-86 this grant is $9.20 per student. Although Alberta Education identifies priorities for teacher inservice each year, school boards may use these funds for other priorities that have been locally identified.

Curriculum

Alberta Education has developed curricula for computer literacy for all levels of schooling. About 74% of Alberta's elementary schools offer computer literacy as do 82% of the junior high schools. At the senior high level, 25% offer computer literacy, 71% offer a course in computer processing and the remaining 3% of schools have indicated that they introduce computer literacy as part of one of the existing subject areas.

In addition to the computer literacy curricula, Alberta Education has made significant changes to the Business Education curriculum. These changes reflect the growth in the use of technology in business and better prepare students taking these courses for the workplace.

Networking

Alberta Education is piloting a wide area network that will electronically connect the department with the five Regional Offices of Education and with school district offices. This network is intended to be used as a bulletin board, for electronic messaging/electronic mail, and for the transfer of files.

Facilities

In November 1985, Alberta Education released a report intended to assist facility planners and designers when considering school computer facilities. This report emphasizes important planning considerations and design criteria, which will assist in ensuring that school computer facilities will fulfill local educational needs.

Consolidating Achievements

In January 1986, Alberta Education, in co-operation with a number of other agencies, held a Symposium for Strategic Planning for Computers in Schools. Participants formed a number of working groups, reviewed what has been accomplished and tackled issues related to eight topics: the planning of school facilities; evaluation, development and acquisition of courseware; training programs for teachers; the instructional potential of computer networks; integrating computers into the elementary, junior high and senior high curricula; and administrative uses of computers. Participants prepared a set of recommendations for each topic which Alberta Education is now reviewing.

The Symposium indicated that although many steps have been taken encouraging and exploring the educational uses of computers, the road to achieving the objectives set out in 1981 is yet a long one.

Even though computers have been introduced into Alberta schools in relatively large numbers, the demand for more computers continues to outstrip the ability to provide the needed financial resources. Perhaps more critically, as the figures for the Clearinghouse show, there appears to be a lack of quality courseware for computer assisted instruction. Although the Government of Alberta is considering means for addressing demands for hardware and promoting the development of software in areas of greatest need, it also recognizes that these are not the only issues that need to be faced.

Research is both needed and crucial in determining what effects computer use has on instruction and learning. Findings from such research could provide us with a sounder direction and framework for future activities so that computers can be used to the very best advantage in developing the knowledge, skills and positive attitudes our children will need to meet the challenges they will face in the future.

Furthermore, we must be able to assess the changes, and the resistance to changes, which current technology and computers may well produce in schools and in the relationships between students, teachers, homes and schools. We not only need to envision the kinds of changes which may occur, but also the kinds of changes which we want to encourage, direct, and take place. In considering the kind of dramatically new educational system we may have in the future we must be prepared to move step-by-step from our current model to a desirable future one.

MANITOBA

Edward Buller, Assistant Deputy Minister, Department of Education

Manitoba Strategy to Stimulate the Implementation of Educational Technologies

A. Computer-assisted learning has come of age. The future of Canada will depend on the effectiveness of its society to adapt, develop and prosper in a highly competitive international arena. The educational systems from kindergarten to universities need to evolve in parallel with technological advancements covering all aspects of the educational spectrum.

The use of computers supported by computer assisted/managed learning systems promises to provide students with the opportunity to maximize their potential. Manitoba began to implement computers based on a grass roots movement by teachers interested in these tools. Several school divisions have launched programs to support the implementation of computers in schools, to select, and/or promote the development of software/courseware, but:

(1) Are the teachers being trained to effectively use these tools?

(2) Are computers used effectively by students?

(3) Is the courseware tailored to curriculum needs?

(4) Is industry receiving a reasonable direction regarding requirements and standards for the development of effective courseware materials that satisfy Manitoba's educational needs?

(5) Is the educational system taking a serious look at the need to revise or expand the curriculum to effectively implement those tools across all curriculum disciplines?

(6) Are the investments made by the school systems in these technologies effective — today and tomorrow?

Many more questions like these can be asked, and yet it is very difficult to provide satisfactory answers. Manitoba began using computers in support of computer studies curriculum in the early seventies. The advent of the micro-computer was identified as an opportunity by a small number of pioneers who began developing software and courseware to address a variety of educational problems. Yet the educational system was relying mostly on spare dollars to allow the use of computers in the schools, with little leadership from the formal curriculum development process.

B. In 1984, the Departments of Industry, Trade and Technology and Education formed a unique partnership and devised a strategy to promote the development and implementation of technologies within the K–12 educational system. An assessment of programs across Canada and abroad was made to formulate a program for Manitoba. The elements of such a strategy were established as follows:

(1) The program must have active participation by industry;

(2) The program must perform a catalytic function, stimulating the supply and demand of products and services most appropriate to support the educational system, respecting the forces governing the market place;

(3) It must have a long term economic development focus, while satisfying the short and medium term needs of the educational system, through an effective technology transfer process; and

(4) It must be comprised of a comprehensive set of projects and activities which cover most if not all areas of support needed to promote the development and use of educational technologies.

C. To implement this strategy Manitoba established the Information Technology Program (InfoTech). The program is comprised of four major components, all interrelated and cross-supported, as outlined by the following mission statements:

(1) *Business Development Program (BDP)*

To promote the development of business and markets for information technology industries, thereby increasing long term economic development and jobs.

(2) *Business Technology Program (BTP)*

To promote awareness and use of information technology by small and medium sized business, thereby increasing their effectiveness and competitiveness, resulting in improved employment opportunities.

(3) *Educational Technology Program (ETP)*

To promote and support the implementation of educational technologies in the K–12 school system through a joint industry-government initiative, while promoting the development of an educational software and courseware industry.

(4) *Infotech Resource Centre*

To operate a world class resource facility with public and private resources, to support technology transfer and technology development programs, for access by educational, business and organizations interested in advancing the application and use of information technology.

ETP brought together eight major partners and an increasing number of other private companies to establish Canada's first industry-government Computer Resource Centre. Apple, Burroughs (ICON), Commodore, Cybershare-MTS, Epson, IBM, Sperry and Tandy as major industry participants have committed in excess of 4.3 million in support of a three year base program.

These companies provide hardware, software, technical support, master purchasing agreements, and an array of projects to advance the use of these technologies in the schools. Manitoba's strategy is to support commercially available hardware which satisfies the education and computing needs of the schools, as it does not have the resources to pursue strategies similar to other provinces.

D. Education Technology Program

Projects and Activities

The premise of ETP is that the best approach to facilitate the acceptance of technology in the English, French and French immersion schools resides in the degree of knowledge and proficiency that teachers have in their use. Children are increasingly being exposed to the use of home computers, constantly challenging their teachers in their proficiency with these tools. Hence, the ETP embarked in establishing a series of support projects directed to teachers to help them in the process of understanding the use of educational technology. The following provides an overview of projects implemented.

(1) *Consultative/Curriculum Development Support*

This service is delivered with the assistance of six ETP consultants to support teachers in the effective implementation of computer awareness, computer sciences, and computer assisted learning throughout the K–12 curriculum.

The consultants liaise with curriculum development consultants of the Department of Education to establish direction for the use of technology across the educational curriculum.

This group organizes workshops and in-services for teachers at the Resource Centre and in the schools. Their three-year objective is to reach over 70% of the teacher population of over 13,600 teachers. Their workshops cover computer curriculum, hardware, logo, networking, computer programming, software support tools, work processing and an assortment of other topics of interest.

In concert with industry participants, several projects have been undertaken in areas of business education curriculum, writing to read programs, technology applications for children with special needs, etc.

(2) *Technical Support*

Six technical consultants are available through a hot-line and electronic mail service to provide direct assistance to computer co-ordinators and teachers in the solution of problems they may encounter.

They are available on selected days in evenings and Saturdays to assist teachers visiting the Centre. When not engaging in such support activities, they are involved in the development of software and courseware, as well as applications for the educational communications network. The courseware and related user guides are distributed to the schools and will be placed on the market for licence outside the Province.

(3) *Manitoba Courseware System*

This project has the responsibility to establish an ongoing process of acquisition, evaluation, development, reporting and distribution of educational courseware. Consultants will be responsible for the establishment of evaluation guidelines and the co-ordination of their development with efforts in other provinces.

InfoTech, in partnership with the Text Book Bureau, provides the central co-ordination for the licencing, duplicating, cataloguing and distribution of courseware materials. Purchases can be made by phone or through the communications network with all revenues reinvested into projects undertaken by this group.

InfoTech also provides an incubator space to support teachers or individuals with their development of courseware. Up to 20 workstations equipped with micro-computers are available for long term projects. Financial, market development, technical, administrative and authoring expertise is provided through the centre.

InfoTech also supports the Manitoba Computer Assisted Learning Consortium (MCALC) through an annual licence of their courseware for the Manitoba school system, as well as providing the consortium with marketing and distribution support.

(4) *Manitoba Distributed Network*

Building upon the computer support services provided to schools over the past 10 years, InfoTech helped establish a public access network for schools supported by Cybershare Ltd. and the Manitoba Telephones System. All schools can connect to the network on a flat fee with unlimited access per year.

A Remote Micro-Facility was developed to permit most makes of micro-computers in schools to interface with a Control Data Cyber 830T mainframe. The network offers access to school administration systems, compilers, data bases, electronic messaging, bulletin boards and mass storage. Teachers can have access to the catalogue of software and courseware, with the option to access information in English and French.

The long-term direction for the network involves providing access to students from their homes and the development of information data bases. The network will be accessible by private information providers, museums, libraries and other public service and private organizations interested in the diffusion of information to schools.

(5) *Special Projects*

The resources available through InfoTech are used to promote special projects for schools. These include the micro-computer loaner program of over 40 IBM PC's, a mobile classroom unit to support business education using Sperry PC's, the organization of symposiums, seminars and workshops to promote the use of technologies for the disadvantaged, computer based music composition and specialized applications such as school administration and library information systems, etc.

(6) *Public Communications*

The ETP publishes on a bi-monthly basis a newsletter to address topics of general interest to schools, as well as to publish information of projects outlined by either ETP or its users. These services also include the distribution of information regarding pricing for hardware which have been negotiated under agreement with industry participants.

(7) *Hardware/Software Purchasing Agreements*

Industry participants signed master purchasing agreements to provide every school with equal opportunity of access to the acquisition of hardware and software, regardless of the size of the purchase. This program has provided significant savings to help accelerate the process of implementation of technology in the schools.

(8) *InfoTech Resource Centre*

The ETP is housed in a 33,000 sq. ft. facility which opened its doors in September 1985, 18 months after it was conceived. The Centre provides:

— an industry display area conveniently opened in evenings and Saturdays to provide teachers with a friendly environment to drop-in and examine hardware and software;

— a library, supported by an advanced library management system that teachers can use to search for software and courseware materials comprising over 3,000 titles located at the Centre or at any other remote site;

— six model classrooms, each capable of supporting seminars and workshops for over 20 teachers, supported by local area networks and telecommunications;

— a lecture theatre with a capacity of 56 seats, equipped with modern computer and video projection equipment and telecommunications;

— five seminar/meeting rooms, and a space to house large conventions in the range of 100–300 visitors;

— a local area network and integrated office system, supported by a SLI digital switch and an IBM System 36 minicomputer, to provide demonstrations in adminstrative systems for schools, professional and administrative support services and support the Centre's external data communications;

— a purchasing and distribution facility to process courseware orders by the schools on all licenced materials of the ETP;

— office facilities ergonomically designed to support the activities of up to 47 staff; and

— the Centre has in excess of 700 micro-computers and specialized equipment needed to support the activities of a modern technical centre.

E. Organization

InfoTech, while reporting to the Department of Industry, Trade and Technology, operates in close co-ordination with other departments. The activities of the Educational Technology Program are monitored through an advisory committee comprised of senior representatives of organizations in the school system and it is chaired by the Department of Education.

DISCUSSION

CHINA

How will this technology help developing countries and their educational problems? China takes only one-sixth of university applicants, and will rent satellite space this year. Given those facts, I have the following questions:

(1) Will TV really help us? Can it be the major teaching method in the latter part of the 1980s?

(2) How can we teach teachers to use technology? Have any Provinces done this?

(3) In middle to primary schools, will we have computers as a major method of education, or will it be an adjunct?

(4) If new technology enters into different classes, costs will be high. Is it worth it? Has Canada raised its education budgets as a consequence?

ALBERTA

Canada is trying to change tradition in adopting new technology. China does not have that problem. However, you must keep in mind that technology will never replace human interaction. The most important thing to realize is that technology will not reduce costs unless you adopt an entirely different system. We cannot do that. You might be able to.

ONTARIO

We feel that computer-based learning is practical. Education has a large training component, and computers can be used for that purpose. We estimate that in some grades 70 per cent of education time could be used for computer instruction.

MANITOBA

We do not feel that we can re-define education to make it fit modern technology. Computers can do some things, but they are not a replacement for well-trained teachers.

THAILAND

Can we use computers other than as a supplement to teachers? Ontario says we can, Manitoba says no. If we could, how would costs compare? Would the technology last any length of time?

ONTARIO

The costs are coming down. You have to build up domestic manufacture, so that you are in a position to advance with the technology.

GHANA

How much is enough to spend? Why do you all have different hardware? Why are you all going in different directions?

ALBERTA

You have put your finger on one of the peculiarities of Canadian education. We do not agree on many things. We have recently, however, agreed to co-operate on a clearinghouse for software analysis operated by the Canadian Ministers of Education Central Secretariat, so we are getting better. There is an advantage to our lack of cohesiveness. If someone makes an error, the rest of the country will learn from it.

ONTARIO

We went in the direction we did because we felt that none of the available hardware was up to much. It would not run the sort of complex software education needs. As a result, we set our own specifications and asked manufacturers to meet them. As far as we are concerned, if you want software that is easy to use, it has to be sophisticated and complex behind the scenes, and needs powerful, specialized hardware to run it. The ICON (the Ontario Education Micro-computer) is still the leader in the field.

MANITOBA

If we had all started at the same time, we would perhaps have all gone the same way. As it is, the market has shaken down, and is still evolving. As you come into the field you find some avenues have been closed and others open, so you take the best pick at the time. Three months later, someone else will make a different choice.

ZIMBABAWE

The point raised by China prompts me to ask again: You can afford to experiment, because you have a sound infrastructure. How about us? Can we avoid the infrastructure and the cost? Can we go directly to what you are experimenting with?

ONTARIO

You can start where we are, and avoid the conventional system. With care, you can make it work.

MANITOBA

But you will need some structure, and very careful planning. Computers cannot entirely replace teachers. In fact, they probably cannot replace them at all, but they can allow a teacher to serve more students — some with distance learning.

ALGERIA

We cannot repeat your experience — the times have changed. What we must do is obtain co-operation from the suppliers. How can we do this without doing what you have done?

ALBERTA

Do not let them sell you. You must formulate your own plans, and then go shopping. If you need assistance, approach an agency like CIDA (Canadian International Development Agency) and ask for help.

MANITOBA

Analyze expected gains and the costs. It must be cost-effective.

UGANDA

Is there a qualitative advantage? Do students learn better? And can we afford to wait? Will our pupils be computer illiterate?

BRITISH COLUMBIA

You can afford to wait. There is no evidence that computers help students learn better, and as for computer literacy, computers are becoming so simple that anyone will be able to use them with no training at all.

SINGAPORE

See Lai Tan, Deputy Director, Ministry of Education

(Singapore did not provide a paper. These are notes on the presentation.)

In 1979, Singapore revamped the educational system. We had had an ETV pilot for 12 years, and it had gone nowhere. At that point, I was asked if I would be willing to attempt a new direction. I said I would under two conditions: I wanted $50 million committed for educational technology, and it would go only to schools that indicated they were ready for it, rather than on a general basis.

Of course, Singapore was ready generally. Our students were used to TV, and were ready to embrace technology. The teaching profession was not so ready. We decided that we should not rush into the newest developments, but should start with things teachers knew. We decided to start with slides, tapes and games to supplement texts.

First, we brought principals together and explained what we were doing. We asked for schools to apply to be part of the enterprise.

Then we trained a key teacher in each participating school. They were paid for their time. It is very important to have the right key teacher! If you do not, it will not work.

These teachers had 60 hours of training over a three-week period.

We then obtained films from any and all sources, and loaned them to schools. Teachers became used to integrating media into their lessons.

We approached computers carefully. In 1980, we installed mini-computers in our junior colleges, and the Ministry ran workshops on applications for teachers.

In 1982, we started computer clubs in selected schools. We also provided 100 hours of teacher training on Government time. We provided dollar for dollar, matching grants for computer clubs to purchase equipment.

Currently, almost all our activities are focused on the secondary schools. We are not sure of the value at elementary grades. We are, however, experimenting with WICAT curriculum in one school.

AUSTRALIA

Yvonne F. Gosselink, Western Australian Technology Directorate

Western Australia

Area:

Over 2½ million km^2	approximately one-third of Australia

Population:

1.36 million	less than 10% of population
	just over 2% of population *identified* as Aboriginal
1 million	approximately 70% live in Perth, the only major city 2 181 km from any other major city.

Factors Affecting Policies on Educational Technology

1. Sparsely populated
2. Highly urbanized
3. Large distances
4. Cultural isolation
5. Aboriginal and ethnic minorities
6. Cultural bias towards individualism and egalitarianism

General Policy Orientation

1. Technology is not just computers and "high technology".
2. Educational technology is only one factor in process of education.
3. Education for technology is a more important consideration.
4. Use of technologies is a good means for introducing technology awareness and promoting technological literacy.
5. Collaboration between institutions in use of hardware and provision of software is to be encouraged.

Schools

1. Of the 900 schools in Western Australia, 700 are Government schools.
2. Staffing and curricula are centrally controlled in Government schools.
3. Where possible, staff development and administration is regionalized.

Tertiary Sector

1. Two universities and two colleges of Advanced Education located in the metropolitan area.
2. Community Colleges and Technical Education Colleges are strategically located throughout the State.
3. Collaboration between institutions in assisting external students is increasing.

Computers

1. The purchase of computers was previously a school-based decision.
2. The Education Department funded up to 50% of the purchase price of approved machines.
3. The Education Department provided training and software support for all approved machines.
4. Software development within the Department has been a minor but successful role with the quality indicated by the receipt of a number of meritorious awards for software development.

New Policy

1. The Government will provide computers in all Government schools to ensure an equitable distribution.
2. There will be at least an average of three computers provided in each primary school.
3. There will be at least an average of one computer for every 40 secondary school pupils.
4. The introduction will be based upon principles of both equity and the maximization of potential gains through resource allocations.
5. A variety of pilot projects will be commenced to assist in assessing the potential of various implementation strategies.
6. Some special projects for handicapped and remote students will be included.
7. In primary schools, especially, computers will be incorporated across all curricula areas and not be used predominately for drill and practice.
8. Encouragement will be given for across the curricula use of computers in secondary schools.

Networking

1. Some networking amongst school computers already exists and this is likely to be enhanced in the future.
2. Various forms of data transmission will enable remote students to become an external member of centralized classes and vastly increase their available subject options.
3. Sharing information between school groups expands the educational environment in which learning takes place.
4. Access to and use of national and international data bases for assignment work will be encouraged, as will student creation of their own data bases to be accessed by other schools.
5. The power of an individual micro-computer and the range of available software can be expanded through networking with a mainframe.
6. Projects are under way to assess the most effective networking systems to use for school administration and library systems.

Audio Visual Communication

1. Australia's "School of the Air" radio network was an early and very successful response to the problems of distance education.
2. The Education Department provides its own videos for distribution to schools on a loan or purchase basis.
3. Educational radio and television broadcasts have previously been carried via the ABC but a successful scheme utilizing private regional networks has been piloted.
4. The use of either video, radio or television can be enhanced through the use of teleconferencing facilities currently available at some remote locations.

Satellite Communications:

1. The Western Australian Government is committed to the provision of two hours per day of educational broadcast time utilizing AUSSAT, Australia's first domestic satellite.
2. The feasibility of establishing a community education network utilizing both satellite and terrestial communications is currently being considered. Such a system would provide a service for all government and community organizations wishing to provide programs for general or restricted audiences. If and when appropriate, the system would be extended to include interactive communication.

Communications Policy:

As the new technologies increasingly enable the integration of various communications systems there is a clear need to co-ordinate all policies relating to various communications technologies. Hence a specific interdepartmental body has been created for this purpose. All policies relating to educational technology must therefore be viewed in relation to the overall state policies to ensure maximum and appropriate utilization of state resources.

THAILAND

Panom Kawkamnerd, Deputy-Permanent Secretary of Education

Mr. Chairman, Thailand is one of those developing countries which are endeavoring to accelerate the pace of development. Education, as the key to the economic and social development, has been the focus of our attention for the last two or three decades. However, in spite of all our efforts, Thailand still faces many problems and obstacles. Under the present financial constraints, and economic difficulties, the development of education has been slowed down. Some of the major policy directions, such as the expansion of educational opportunities to the rural poor, the upgrading of educational quality to meet the economic and social needs, and the improvement of the management system in order to increase efficiency, are still the most important in the coming Sixth Development Plan. Meanwhile, the employment market throws up many new problems. The number of unemployed graduates has reached an alarming proportion. How to create new jobs, and how to educate younger generations in order to be self-employed, or to be entrepreneurs, have become the most urgent issues in educational circles.

In trying to seek solutions to these problems, the Thai Government authorities concerned with education are gradually applying technology where appropriate. Since this is the new age of electronics, radio, television and the micro-computer have increasingly made their presence felt in the educational system. As well, the non-electronic media, such as books, learning materials and audio-visual aids, have become increasingly an indispensable part of the learning system.

I will briefly describe new applications of educational technology in each area of educational concern as follows:

(1) In educational management, there is no doubt that the role of the computer and micro-computer is becoming more significant. For the Ministry of Education as a whole, the information system is now under the process of computerization. The Educational Management Information Center (MIS) has been established under the Office of the Permanent Secretary for Education. Computer terminals are installed at each Department within the Ministry for easy access to the main computers located at the Center. We are also trying to extend this computerized system to the provincial level. Very soon, it is hoped that the computerized base-line information system will be able to assist top management decision-making in certain areas of educational policies.

(2) In the classroom instructional system, the educational technology comes in a variety of forms: the non-electronic devices, such as audio-visual aids, and the electronic, such as radio, television, and computer-assisted-instruction system (CAI). In the Thai education system, the CAI has not yet become a common feature, but the schools are given freedom of choices as long as they can find additional resources for such innovative enterprise. There is evidence that the CAI is being utilized in some of the private vocational schools. It has been found that in certain Government schools, they have built up their own programs to assist teaching in languages, geography, history, physics and mathematics.

With reference to radio, television and tape-recording, the Ministry of Education has been building up the infra-structure with such developments as a transmission system and studio, to operate the programs for schools at both the elementary and secondary levels. The Centre for Educational Innovation and Technology of the Ministry of Education is responsible for producing two radio programs, one for the general public and one for the schools. It also produces several educational television programs, e.g., "Children's Friends", "Saturday Club", "Knowing is Useful", etc., which are regularly broadcast.

At the higher level, a closed circuit television system is employed in some universities, especially Ramkamhaeng University and Thammasat.

(3) Educational technology has also been applied in the area of teacher-in-service training. For instance, through the distance learning system of the Sukothaithamathiraj — an open university — school teachers can enroll to upgrade their own qualifications. School principals can also take advantage of the opportunity given by the open university to upgrade their management practices. The In-Service Teacher Training Division of the Department of Teacher Training, Ministry of Education also offers courses to teachers, combining radio and correspondence tuition, which are designed for upgrading of qualification at primary and secondary certificate levels.

(4) Education technology has also been applied in non-formal education. In the Ministry of Education, some of the equivalency programs at the secondary level are operated through the radio-correspondence courses. Many thousands of adults in the rural provinces annually avail themselves of the distance learning system to upgrade their own educational qualifications.

From these examples, we can see that the Thai educational system has been increasingly exposed to the new educational technology and is now applying it as part of the teaching-learning system and the planning and management system. The conventional fear that the new technologies would replace the teachers is no longer the problem. What remains to be investigated more systematically is the question of efficacy and costs. How far does the contribution of educational technology go towards the improvement of educational quality? What are the costs involved? What savings can be made? These are legitimate questions to raise for future research and action.

BRITAIN

Stuart Taylor, British School of Technology

(There was no formal paper provided. This is a brief description of the presentation.)

British School Technology is located in the Carlton Institute in Bedfordshire, north of London. It operates a number of projects, including teacher training, consultancy, and travelling technology labs for student use.

These labs are equipped with computers, design aids and pneumatics, and visit schools to provide a lab facility at an affordable price.

The essential feature of the program's success is committed teachers. All these courses call for intensive study — long hours and concentrated work. Participants must be enthusiastic.

We feel it is important that there be a tie-in to examinations. Cambridge exams test all our instructional goals, for teachers as well as students. This gives our programs credibility.

MICHIGAN

Daniel Schultz, Administrative Assistant, Department of Education

Introduction

It wasn't too long ago, in the depths of the national recession, that *Business Week* magazine described Michigan as "the financial basketcase" in the United States. Our credit rating was worthless, over 17% of our people were out of work, and our schools and universities were suffering from neglect and lack of confidence.

Today, Michigan is well on the way to economic recovery and a key component of the recovery plan is the state's education system. In the future, Michigan's economy will be tied to industrial technology and manufacturing. It is essential that our education programs adequately prepare Michigan's students and adults for technical jobs in business and industry.

Our 3,300 public schools enrol 1.6 million students in kindergarten through twelfth grade, and our 1,300 non-public schools enrol 213,000 more. The State's 567 autonomous local school districts are governed by locally elected school boards. Michigan's elected State Board of Education has constitutional responsibility for leadership, planning, and co-ordination for public education.

Michigan is a culturally diverse state of over 9 million people and shares a 721-mile joint boundary with Canada. Approximately 45 per cent of the population is located in the metropolitan Detroit area. The balance is distributed throughout the state in urban, suburban, rural and sparsely-populated areas.

Proficiency in foreign languages has become a priority in Michigan's schools to promote trade and the transfer of technology with other countries.

There are over 50 languages other than English spoken by our students and we have the highest concentration of Arabic-speaking students in the United States. Through its sister-state relationship with the Shiga Prefecture of Japan, Michigan has developed a Japanese teacher exchange program. Japanese investment in Michigan is bringing large numbers of Japanese families to Michigan which presents unique social and educational opportunities.

State Education Initiatives

The State Board of Education, in January 1984, identified major initiatives related to the improvement of public education in its report *Better Education for Michigan Citizens: A Blueprint for Action*.

The State Board of Education used four key principles in developing its plan for educational improvement. Those principles are:

(1) Improving Learning;

(2) Creating a Learning Environment;

(3) Strengthening the Profession; and

(4) Delivering Educational Services.

Several groups of educators, policy makers, and technology experts were convened at the state level to develop proposals and make recommendations to address these issues. Among the key recommendations was the accelerated use of new and emerging technologies to expand the range of courses and programs in advanced and specialized areas. It was also recommended that the Department of Education take steps to better co-ordinate and maximize the use of technology in education. The Michigan Legislature established a discretionary grant fund to expand the use of technology in Michigan public schools. Based upon a 1985 analysis it was determined that approximately $10.6 million in funds were being provided annually by the Michigan Department of Education for technology projects.

Technology Applications

The Michigan Department of Education is making use of technology through teleconferences, instructional television, electronic networking systems, computer utilization for instruction and management, interactive television, and robotics. Some of these applications are in a developmental stage. Others are operational. The State Board of Education's *Blueprint for Action* has served as the impetus for this effort. A parallel force is the need of students, teachers and school administrators to be able to function in an increasingly technological society. The remainder of this paper describes the implementation of programs which are in operation. These programs represent major efforts in several areas. Finally, a description of the identified needs and future expectations is given.

Computer Education

Michigan's Governor Blanchard made computer competency one of his priorities by issuing the following challenge: "By 1988 every student in our state will have access to a computer and the skills to use it." With funds provided by the State Legislature, a network of five micro-computer resource and training centres covering the entire state has been established. Representatives of the regional centres, and the Michigan Department of Education comprise the Michigan Microcomputer Network Committee, which co-ordinates micro-computer training and software evaluation on a statewide basis. A group of 50 school personnel across the state are training teachers and administrators on the use of computers for instruction. The training is based on 14 modules developed by the University of Michigan. Co-operative purchasing specifications and agreements for equipment and software are being developed.

A statewide inventory of micro-computer hardware and software is currently being conducted. This survey is gathering data regarding the numbers, types, and uses of micro-computers in Michigan and the titles of the most frequently used software packages. The results will be used to expand efforts to support both instruction and administration, and emphasize curriculum applications.

The impact of our efforts in computer technology as tools in the instructional process is evident through the following examples:

— ⅔ of the districts offer at least one semester of computer education;
— In a statewide opinion poll of Michigan citizens, 81 per cent of those surveyed expressed support for one semester of computer education as a requirement for high school graduation;
— Almost half of Michigan teachers surveyed in 1985 reported that they use computers in their classrooms;
— Minimum performance objectives for local assessment of computer education are being developed for distribution;
— To prepare teachers to use computer technology, the State Board of Education has approved criteria for teacher certification in computer science. To date, 16 teacher preparation programs in computer science have been approved.

When the State's computer education program is fully implemented, every teacher and school administrator will have access to training on the use of micro-computers in the classroom.

Telecommunication

In 1986, approximately $1.4 million has been awarded to school districts and other agencies to plan, implement, or disseminate information related to instructional television. These projects relate to curriculum, instruction, and administration.

Statewide Video Acquisition

Perhaps the highlight of Michigan's technology efforts is Project M*STAR (Michigan Statewide Telecommunication Access to Resources). Through Project M*STAR, the state acquires duplication and dissemination rights of the instructional television program series provided through the Interregional Technology and Education Coordinating Council. Now in its second year, programs presently carried on the Westar IV satellite are available in every content area. The project provides co-operative purchasing arrangements for satellite receiver hardware and related video equipment. Training activities are provided for teachers and administrators to incorporate instructional television programming into the curriculum. The teachers' guides to accompany each program series are available to all classroom teachers using the programs. These instructional television programs are available to all students in grades K–12 throughout Michigan.

With advances in telecommunication technology and its subsequent impact in education, the M*STAR project is providing high-quality instructional television programming. Michigan educators are receiving information and training to enable them to use this vast and developing resource. Training has been provided via a teleconference, two statewide conferences and four regional conferences to several thousand participants. A closer relationship between school districts and public television stations has emerged. As of May 1986, over 1,000,000 Michigan students are receiving instruction.

Local Video Utilization

To maximize the impact of instructional technology, teachers need training to help them to incorporate video resources into their classrooms. Local Video Utilization projects are designed to train classroom teachers in the use of instructional television programs such as those acquired through Project M*STAR. The training models developed by these projects are designed to be used to train teachers throughout the State. The State's 22 Regional Educational Media Centers will design and conduct workshops based upon these models and local needs.

Other Telecommunication Programs

The Michigan Department of Education has contracted with the Michigan Community College Association to conduct a feasibility study to link the State's 29 public community and junior colleges. The establishment of this network will enable these post-secondary institutions to share resources and avoid duplication of effort. Existing telecoursing and teleconferencing activities will be expanded to provide virtually unlimited course offerings for students. The satellite network is an important part of the K–12 and post-secondary co-ordination and resource sharing efforts.

The electronic transfer of information is a growing application of technology in Michigan. The 22 regional media centres and the Michigan Department of Education have daily electronic bulletin board contact. School districts and higher education institutions may, for a nominal fee, participate in the electronic bulletin board.

The use of the teleconference as a means of communication and inservice is becoming increasingly viable. This is due in part to the growing number of satellite receiving stations across the state. The Department of Education co-ordinates teleconferences for the National Diffusion Network of the U.S. Department of Education. In addition, Michigan will be experimenting with the use of teleconferencing to deliver information to students and parents about student financial aid.

The Michigan Legislature provided $350,000 in 1986 to the Department of Education to develop a model two-way interactive cable television system. The region of the State selected for this pilot study had 12 local school districts enroling 27,883 students. The system will demonstrate an alternative method of providing academic instruction, training, and transfer of data to areas of the state with low enrolments, or broad geographical distances.

Conclusion

The application of technology in Michigan education has the potential to benefit all students and adults in the state. As a resource and method of delivering instruction and training, telecommunications and computer education programs are providing education which will enable each student to take advantage of tomorrow's opportunities. The education of our students is an investment in Michigan's future.

As the state moves to institutionalize many of the technological applications, a set of *issues* and *problems* must be addressed.

(1) Each of Michigan's school districts is individual and autonomous, governed by a locally-elected school board. This history of local autonomy has a direct bearing on the number of school districts in the State.

(2) Each school district maintains autonomous local bargaining units and local collective bargaining agreements. Issues such as class size, preparation time, equipment, training, teacher evaluations and course scheduling are negotiated.

(3) Michigan has historically resisted the establishment of a statewide curriculum. Each local district establishes its own program and curricula.

(4) Michigan's public two-year and four-year colleges and universities operate independently and resist state-level co-ordination.

NEW YORK

Dr. Peter F. Stoll, Assistant Director, State Education Department

There has been a rapid infusion of computers, telecommunications systems, and video technologies within New York State educational and cultural institutions during the previous half decade. The Center for Learning Technologies, created by the New York State Board of Regents in Fall 1982, was charged with the mission of developing a strategic plan for the effective use of these technologies and new policies to guide the implementation effort. Three issues related to the learning technologies have been the focus of significant State Education Department initiatives during 1985-86:

(1) The need to assure equitable access to computer technologies for low-wealth and economically disadvantaged schools;

(2) The need to systematically plan and implement "distance learning telecommunications networks" amongst small schools with declining enrollments for the provision of enhanced learning opportunities;

(3) The need to develop guidelines for the creation of public-private partnerships to achieve enhanced quality in instructional technology.

A brief overview of the rapid acquisition of computer and other learning technologies by New York State schools will serve as a context for appreciating the complexities of each of the current policy issues.

The Infusion of Technology Within the Public and Nonpublic Schools

Annual survey data gathered by the Education Department's Information Center on Education provides dramatic evidence of the rapid acquisition of computer technologies by the total public/nonpublic schools of the State. For example, the public/nonpublic schools acquired 69,484 micro-computers during the 1984-1985 school year; this number increased to 106,214 micros during the next 1985-86 school year, which represents a 52.9 per cent increase.

Data on the acquisition of other learning technologies by New York State public/nonpublic schools underscores the emerging use of broadcast, video, and telecommunications technologies. In 1985-86, the public/nonpublic schools acquired 15,729 video cassette recorders, which was a 43 per cent increase over the previous year. There was an installed base of 42,222 television monitors, and, for the first time, the schools had acquired nearly 100 satellite dishes for the reception of transmitted programming. Over 71,000 teachers were using television as a tool of instruction. More than 2,500 schools had installed cable networks and 4,323 of the total 6,287 public/nonpublic schools had received capability of public broadcasting programming in support of curriculum and programs. The data on computer acquisition is particularly important with respect to equity issues. The data on video and telecommunications technologies illustrates the emergent role of distance learning technology within the schools.

Equity

Equity is a Regents priority goal and the need to assure equitable access to technology resources for all populations has been actively pursued by the State Education Department with dramatic results. Data gathered in 1984-85 indicated that New York State schools having a major per cent of their students on welfare (91–100%) had an average of 7 micro-computers per school as contrasted with schools having a small per cent of students on welfare (1–10%), in which there were 16 micros per school.

Furthermore, schools with 91–100% of students on welfare had an average of 98 students per micro whereas schools with 1–10% of students on welfare had 38 students per micro.

The major policy concern related to this data was the need to increase the number of micros available to schools having a majority of students on welfare and to decrease the number of students per micro in these schools to provide enhanced access to the technologies. By the next school year, the data indicated that schools with 91–100% of students on welfare now had an average of 22 micros per school, which is a growth from the 7 micros per school of the preceding year. Also, the schools with 91–100% of students on welfare had reduced the ratio of 98 students per micro to 33 students per micro.

Although there are many reasons which account for these positive trends, at least two State Education Department initiatives for closing the "gap" between the "have's" and "have nots" should be noted. First, State-aid provided to the schools for the acquisition of computer technologies was targeted upon those schools in need, thus providing enhanced fiscal resources to acquire computers. Second, negotiations were undertaken with the technology producers to reach agreement that corporations would, as a matter of corporate policy, provide "up front" price discounts on the cost of the technologies for New York State educational and cultural institutions. These agreements lowered the price of the technologies statewide and, thus, brought the cost of the technologies closer to the resources of many more school districts than ever before.

Distance Learning

There has been a phenomenal growth in the planning and implementation of distance learning networks throughout the nation as schools, colleges, and cultural institutions struggle to provide higher quality education in an era of declining resources. The application of telecommunications systems to allow for the remote delivery of learning to students represents an emerging technology trend that will probably supersede the impact of stand-alone computers upon learning and educational systems. A distance learning network consists of a master teacher and a class of few students (5-6) in one school linked interactively to other students in classes in other remote schools. The teacher and students converse and learn over distances through a telecommunications medium, such as cable, telephone-based systems (computers and modems), or microwave. The networks allow for the transmission of both visual and audio signals and, therefore, both the teacher and students are able to converse with and see each other, despite the fact that they may be separated by miles.

During 1985-86, the Center for Learning Technologies gathered descriptive information on 26 newly formed distance learning projects, which involved the co-ordinated planning efforts of both the schools and the post-secondary institutions. Nine of the currently operating projects have offered advanced placement courses in calculus, geometry, second languages and economics. The remaining 17 projects are engaged in planning and are exploring a wide variety of satellite-based telecommunications applications for implementing their distance learning networks. Most significantly, the 26 projects, all of which emerged during a single year, involve nearly one-half of the 731 public school districts and one-half of the 43 Boards of Cooperative Educational Services (BOCES).

Most of the distance learning projects have been undertaken by small schools with limited or declining enrollments because telecommunications technologies represent an efficient application that allows a small school to offer enhanced teaching opportunities or access to courses that would not otherwise be undertaken because of limited fiscal resources.

The New York State Center for Learning Technologies has begun several initiatives to address many of the issues and concerns related to this rapidly emerging technology. First, there is an immediate and vital need to provide information, planning models, and appropriate staff development assistance to schools who wish to explore distance learning technologies. Responding to the challenge, the Center has initiated the following:

- Developed descriptive profiles on each of the projects which contain information on the nature of the telecommunications technology employed, the curriculum taught, the grade levels addressed, sources of funding, evaluation data, and primary program and technical assistance contacts.
- In February 1986, the State Education Department worked with other statewide organizations on developing numerous workshops in distance learning for a statewide Learning Technologies Fair, which is typically attended by approximately 1,500 educators from all sectors of the state.
- The Center also produced in February 1986, a teleconference on distance learning, which was broadcast live over the entire PBS network throughout the state to millions of citizens, to enhance

understanding of the technology, profile the projects, review the issues, and answer direct inquiries from the field.

- Since many of the projects incorporate video production techniques and over 71,000 teachers are using video in their classrooms, a statewide Video Production Workshop is being planned for July 1986 which will follow a train-the-trainers model to insure that a cadre of professionals are trained on the use of video production techniques across the state. The program will be replicated and installed in key staff development sites.
- Finally, a major publication has been planned which will focus on video programming as a "stand-alone" resource, video production as a tool of instruction, and examples of distance learning networks.

There are several major policy concerns and issues related to the distance learning networks which the Department has begun to explore:

- There is a need to provide effective statewide fiscal resources to schools to underwrite the cost of planning, provide technical assistance, implementation and operations of distance learning.
- There is a need to provide effective statewide management of the current and future distance learning networks to assure that appropriate planning has occurred, that the implementation of the networks is based upon an adequate base of research and needs assessment data and that planning is a multiple-agency effort that takes into account existing telecommunications capacities that could be utilized at greatly reduced costs as opposed to installing redundant or duplicative systems.
- There is a need to gather evaluative data. What curriculum is most appropriate for teaching in a distance learning network? What are the effective network models to guide planning? What is the impact of teaching via a network vs. a traditional class mode upon student learning? What supporting resource materials need to be developed for distance learning? What are the comparative costs of different telecommunications technologies?
- There is a need to address other issues. If a master teacher, who is accredited in one state, is linked electronically to students in another state, in which the teacher does not hold accreditation, what is the policy for handling this accreditation issue? If a master teacher in one school is teaching students remotely in several other different school systems, then by whom or what school district is the teacher employed? If a school district teacher contract specifies a specific maximum number of students per class, how is this to be resolved in light of the fact that many electronically enrolled classes may exceed the class size limit? Is there a special certification program that needs to be designed for the preservice teacher education programs for distance learning teaching?

The Regents Advisory Council on Learning Technologies, an advisory group comprised of field-based representatives, has recommended the development of a major legislative proposal for submission in the 1987 package to provide funding for effective planning and research, the provision of technical assistance, implementation and operation of distance learning networks. Recently, a bill was introduced by the Chair of the New York State Commission on Rural Resources to provide funding to the Department to manage the distance learning projects and to develop models of effective curriculum for distance learning networks.

Public-Private Partnerships

The New York State Education Department has taken a national leadership role in forging effective alliances between producers and educators to address the need for enhanced qualities and standards within the technologies. The Department has initiated numerous "partnerships" with specific producers of both computer hardware and software products aimed at the following objectives:

- *To ensure a close match between the goals and the objectives of computer software, as well as the pedagogical theories that underlie the product, with the theories and curriculum objectives of the school.* This has been accomplished by bringing together commercial designers of products with educators in "publishers forums" to discuss the need for enhanced qualities in computer software and to negotiate a corporate commitment to target future product development activities in those content areas designated as priority by the Department. The July 1983 Software Colloquium, reported in *Electronic*

Learning, is an example of a Department forum. Other techniques have involved the development of guides which provide a correlation between the objectives of the products and the curriculum. The State Education Department is producing a guide for the *Voyage of the Mimi* program.

- *To provide donations of new technology products at the State Education Department's computer training facility and at focused sites across the state where the products can be evaluated and tested.* Donation programs were negotiated with IBM, Honeywell, Prime, Victor Technology, Commodore, Apple, JAM, Video Vision, AT&T, Mindset, and Data General. Through this effort, the Center has achieved nearly $5 million in consigned hardware in a two-year period. Also, the Center has worked with corporations, such as Corvus Computer, Inc., to establish a national foundation program to place technology within the schools under grant awards.
- *To provide "model" statewide price discounts on products available to all educational and cultural institutions as a matter of corporate policy that do not involve prior agreements to purchase or statewide contracts.* The discounts have ranged from 15 per cent to as high as 46 per cent. Companies which have recently participated in this program include JAM, Inc., a videodisc company, and Holt, Rinehart and Winston.
- *To make a specific commitment to support effective staff development programs on the new products by hosting statewide and regional training sessions.* Recently, Apple Computer offered several regional conferences, or Publisher's Forums, across New York State to stimulate a dialogue between publishers and educators regarding the impact of the new K–12 curriculum and testing mandates of the Department upon future software development. Thousands of teachers have attended these conferences.

Despite the obvious effectiveness of these partnerships, there is a need to assure that Department interaction with producers is not construed as "endorsing" a particular company. Thus, the Regents Advisory Council on Learning Technologies recommended to the Board of Regents the development of a policy to govern these relationships and urged that the policy address the following:

- The policy should not restrict competition but rather encourage it.
- The Department should not be placed in the position of endorsing a commercially developed product.
- Members of the Department should not profit from such partnership programs.
- The elements of a partnership program should include one or more of the following: a statewide cost reduction program; provision by the vendor of appropriate staff development; and, openness to teacher involvement in the development of products.
- The policy should address copyright provisions, equity concerns, and state licensing agreements in order to provide the widest access to resultant products.
- The policy should incorporate some form of "sunshine provision" by publicly stating (1) what the elements of the agreements reached or negotiated are and (2) the timeline for the partnership effort.
- A provision that the Commissioner has the right to terminate a relationship if it is determined to be in the best interests of the State and the integrity of the Department.

Future Directions

The New York State Education Department is currently pursuing several legislative initiatives and activities to address each of the policies.

Equity

New state aid provisions and specific programs have been funded by the Legislature for 1986-87 to continue equitable access to the technologies and ensure that appropriate staff development activities related to equity issues occur.

- *Special Services Aid.* The Legislature approved an increase of $7.5 million in special services aid to provide for computer acquisition and related services to the Big Five city school districts in which there are concentrations of minority and economically-disadvantaged students.

- *Science and Technology Entry Programs (STEP).* The Legislature provided a $1.1 million increase, reflecting a 230 per cent increase of the STEP program's current funding of $500,000. The STEP program is designed to assist minority and economically-disadvantaged secondary students in acquiring the skills necessary to pursue pre-professional or professional education programs of students *in technical fields* as well as in the sciences and health-related disciplines.
- *Computer Equity Staff Training.* This pilot training program, funded by a Title IV — Civil Rights Act sex desegregation grant, is scheduled for the Spring and Fall of 1986. It is designed to acquaint occupational education teachers with practical information about the inequities that exist in computer access and learning and to provide strategies for promoting gender, race and ethnic equity in the use of computers and other technology for instructional purposes. Major concern will be given to overcoming policies and procedures that unintentionally causes inequities in computer learning. This training will include strategies for infusing the ongoing component of computer instruction into the regular curriculum and criteria for the selection and evaluation of courseware.

Distance Learning and Telecommunications

The State Education Department's Center for Learning Technologies has initiated several activities designed to provide a broad-based source of funding for distance learning and to begin the process of statewide multiple-state agency planning of an integrated telecommunications system.

- *Efficiency Study Grant Program.* The Efficiency Study Grant program for 1985-86 school year funded twelve projects to study the implications of distance learning networks. $140,000 was allocated for these twelve projects, which included the participation of 57 school districts and several BOCES. This program will continue to fund the studies of telecommunications and distance learning networks undertaken by school districts in the 1986-87 school year.
- *Technology Network Ties (TNT).* The Technology Network Ties (TNT) is a pilot telecommunications network which would link the State Education Department, regional BOCES and local school districts for administrative and instructional purposes. Legislation enacted during the 1986 legislative session expanded funding for a statewide computer-based support system for the management of schools as well as for improved information storage and transfer. This provision, which developed out of the TNT program for 1985-86 funded for $1.1 million, provides $3.5 million in 1986.
- *Statewide Co-ordination of Telecommunications.* Legislation has been introduced which would create an Office of State Communications Management for the purpose of developing and managing a co-ordinated communications system for use by State agencies and local governments. This proposed legislation would provide a centralized approach to the acquisition and leasing of additional communications equipment at a greatly reduced cost.
- *Inter-Agency Planning.* The Center for Learning Technologies managerial staff is involved with the telecommunications planning efforts of the Office of the Lieutenant Governor, which focused on the State's telecommunications infrastructure; the Office of General Services Telecommunications Task Force, which is exploring the possibility of establishing a state agency-wide telecommunications network and the NYSERNet Policy Committee, which is designing a supercomputer research network. In addition, the Center has provided research and background information on telecommunications capacities to the Legislative Commission on Expenditure Review, which is currently involved in the exploration of the telecommunications capacities intended for and managed by State agencies. The Center has also provided technical assistance to the New York State Department of Tax and Finance for a complex computer-driven telephone communications system.

Public-Private Partnerships

The Legislature has funded a New York State Teacher Summer Business Training and Employment Program directed at encouraging educator-producer collaboration in developmental projects for the sciences and technologies. Specifically, the Legislature provided an increase of $2 million for summer business training of teachers as well as employer specific training programs for youth, thus bringing the total funded to $6.4 million. The funding provides reimbursement to companies to hire teachers for an approximate two-week

duration during the summer to work on special projects in the fields of science, mathematics, computer science and occupational education. Teachers may seek employment with computer hardware/software companies on a variety of projects that enhance curriculum areas under this program.

Conclusion

The preceding review of these important technology planning issues — equity, distance learning and partnerships — illustrates not only the leadership role that state government must exercise to ensure effective implementation and legislative enactment in support of the technologies, but also the complex issues that must be addressed because of the rapid impact of the technologies upon current educational systems.

DISCUSSION

ZIMBABWE

What is the connection between British School Technology and the Technical Vocational Education Institute?

BST

They are quite separate. The TVEI asked all British counties to submit proposals in 1984, for development of curricula and programs. Ninety authorities now have funding. Those projects are mostly concerned with proven technology — perhaps five years old. BST focuses on the leading edge of technology, and is much smaller.

ALBERTA

What kind of program do students take? What percentage take "A" level courses? (NOTE: "A" level courses are advanced courses, equivalent to Grade 12 academic courses in North America).

BST

We have had 6,000–7,000 students take the program. Many of those have been at an "A" level, but I cannot say how many.

We actually feel our work with teachers is more important, as it reaches more pupils in the long run.

AUSTRALIA

Will these mobile labs work if schools are far apart?

BRITAIN

You would have to set up satellite areas within the larger jurisdiction. Again, you might have to concentrate on teaching teachers.

AUSTRALIA

Dr. Stoll, can you tell us more about the centres for development?

NEW YORK

We established these centres to bring together expertise from universities, industry and the state to study technology in education. They are based at universities, but operate under the auspices of the state as a consortium. All of them have school participation.

HAWAII

Dr. Schultz, you mentioned language teaching. Are languages compulsory in your system?

MICHIGAN

No. We encourage students to take a second language, but it is not required.

ICELAND

Johann Malmquist, Advisory Ministry of Culture and Education

(No formal paper was received. This is a brief description of the presentation.)

Iceland is a very small country. We have 37,000 elementary students in 200 schools, each of which has at least one micro-computer, primarily Apples and B.B.C. Acorns. We emphasize teacher training and application software.

We have 50 secondary schools, with 13,000 students. There are 300 computers. Again, we emphasize teacher training. We also emphasize problem-solving skills rather than programming.

Our greatest problem is the fact that computers to not speak Icelandic. Printers do not have special characters. We, therefore, have difficulty in data input. However, the students are enthusiastic. We hope to solve our problems, and perhaps apply our solutions to other countries.

NORWAY

Arvid Staupe, Head of Secretariat for Educational Technology

The Norwegian Government has prepared a program of action for the next four years. The program started on the first of January 1984, and plans for increased use of computer technology in the schools.

Computer Technology and the School Objectives

In the long run, the introduction of computer technology in the schools will have important consequences for teaching methods, teacher-pupil relations and other aspects of social organization within the schools. The Ministry of Education therefore stresses that educational objectives must be maintained and that computer technology in the schools should contribute to achieving those objectives as they have been formulated in education acts and curricula. This view is expressed several times in the report and will also be stressed in the work that must follow. To avoid unfortunate side-effects, the following should be kept in mind throughout the implementation of the program:

(1) New and sharper divisions between pupils must be avoided. It is important to make sure that the pupils, irrespective of sex, receive teaching according to their interests and intellectual capacity. Equally important is the need to reduce as far as possible inequalities between those who have become acquainted with and motivated towards computer technology at home, and those who do not get the same support at home.

(2) Social interaction in the school should be carefully nurtured. It has become widely acknowledged that "every technology creates its own environment." Careful consideration should be given as to whether the introduction of computers adversely affects co-operation and comradeship between pupils, thus instilling ideals of equality and community spirit. Situations where those who are clever with computers take charge of the technical equipment while the majority are admiring spectators are not acceptable. It is important that teacher-pupil contact is not reduced, in either time or quality.

(3) New, difficult learning situations should be avoided. It should be mentioned, for example, that reading from a display screen or from printouts can present difficulties where the quality is not good enough. Work with computers can also demand a degree of precision, in the use of codes for example, which is too demanding for a number of pupils. Enthusiastic reports of what children can achieve with the computer hardly tell us what all children can manage. The computer should be used to make concrete and visible what otherwise can be difficult to grasp, with a view to avoiding putting even more weight upon theory in the schools.

(4) The choice of teaching material must be diversified so that there will be genuine opportunities for teachers and pupils. Over-employment of programs with mainly drill-like exercises should be avoided.

The Program of Action

The cornerstones in this plan can be summed up in the following points:

— in-service teacher training;
— experimental technology in selected schools;
— development and testing of software;
— computer technology used in vocational education.

1. In-service Teacher Training

Teacher education is the top priority area in which we want to introduce computer technology in schools. In Norway we are now planning and starting to carry out a large-scale program of in-service teacher training. It may take different forms from school to school, but it is based upon some main principles. As an example I will describe how it is planned in one region of the country.

The in-service training is made up of three different types of courses which we describe as A-, B- and C-courses.

A-course

This course will have an extent of 40 lessons and will give the teachers basic knowledge of computer technology and its use in schools. The course is aiming at all teachers in the schools and the lessons will be given during the normal working-hours. We find it most important that the participant can get hands-on experience as soon as possible. Normally, this has been done by a programming course in Basic or another programming language. But now we have chosen to introduce the teachers to text processing, spread-sheet or a database management system.

B-courses

This is not a single course but rather a collection of so-called user-courses. But all these courses are based upon the A-course, which means that the teachers must have completed the A-course before they can be admitted to a B-course. The A-course is complusory for all teachers, but the B-courses are optional, depending upon what subjects they are teaching and what special needs they have.

A typical example of a B-course may be a two-day course in text processing. In vocational education, a course in CAD/CAM is another typical example. But such a course will have a greater extent than two days.

It is very important that the B-courses are not only training in techniques. Much concern must be given to discussions about how the teachers can use the tool in their own teaching. In this way we hope that the course will be related to the teaching of different school subjects.

C-courses

These courses are based upon the A-course and one or several B-courses. It is not the normal type of a course providing specific knowledge. The purpose of the course is to develop educational software. As a matter of fact, we have little experience in this field. But as the need for educational software is great, we hope that such courses can produce something meaningful. Especially within vocational education we hope that such courses can stimulate the teachers to experiment with their ways of teaching.

2. Experimental Technology in Selected Schools

We have limited economic resources at hand for introducing computer technology in schools. Given this hard fact, we may choose either to distribute computers and software evenly to every school in the country, or select a limited number of schools which are given a large part of the resources. We have decided to adopt the second approach. Twenty-one schools distributed all over the country have been selected to participate in innovating projects with computer technology. These schools will be given about 12 computers and the necessary software. The teachers will receive appropriate training, and experiments will go on within a broad range of subjects.

3. Development and Testing of Software

One of the most important objectives in the program of action is to develop good educational software. It might perhaps be suggested that software can be brought in from abroad. With translation into our own language it could perhaps be used directly in the classroom. For many reasons, which I will not explain in this paper, we can only to a very limited extent do it this way. But of course we are studying software from other countries, trying to see what can be used.

We have started to produce our own educational software. The first course in designing software was held in the summer of 1984, and a new one was given last summer. We have started to implement programs built upon some of the designs, and we have just finished the programming part of the process for some of the projects. In this year we are going to test the software in classes in the selected schools which I have already mentioned.

4. Vocational Education

Norway is producing oil in the North Sea. But as a nation, we cannot base our economy only on this industrial activity. We must develop an industrial production which can compete on the world market. For this reason we have realized that we must use new technology in the production. And it is essential for our industrial future that this is based on a modern vocational education.

CNC (computer numerical control) is a good example of the activity which is going on. Three schools have been selected to become centres within their region. These centres will be given necessary equipment and they will be models both as regards the teaching of the pupils and the education of the teachers. A special problem in our country is the scattered population. Usually it is a long distance from one school to another, and this gives us a lot of problems as far as co-operation is concerned.

BRITISH COLUMBIA

Russell Fraser, Minister, Post-Secondary Education

I am delighted to be able to share with you some of our experiences as we struggle with policy issues that the technological revolution has thrust upon us, and I look forward to your advice.

To put our issues in context, I will introduce you to our physical environment. Then, I will briefly describe our post-secondary system and its mission, giving some examples of the projects and approaches we have tried in the process of developing educational technologies. Finally, I will seek your advice on the issues we need to address in British Columbia in the near future.

The Province's geography, economy and populational characteristics all have an influence upon any of the policy decisions we make.

British Columbia has an area of nearly one million square kilometres.

It is about 1 700 kilometres from where we are meeting, here in the southwestern corner, to Fort Nelson in the northeastern corner — that is about the distance from here to the Mexican border, or from the south coast of England to the north coast of Africa.

The southwestern half of the Province is criss-crossed with heavily-forested, rugged mountain ranges, while the northeast is more like the Canadian prairies.

We "enjoy" various climates, moderate coastal rainforests, near deserts in the southern Interior, and more extreme climates in the central and northern areas where temperatures may range from -40 to $+32$°C.

Across this Province we have a population of only 2.7 million. Forestry, mining, agriculture and fishing were the major industries in the past, and now our economy is shifting with increased emphasis on tourism and manufacturing.

Given our climatic extremes and our natural resource base, much of our labour force experiences seasonal fluctuations in employment.

Further, the distances between population centres, the rugged terrain and inclement winters, make travel costly, time consuming and sometimes even impossible.

It is important to give this geography lesson because the nature of our physical environment as well as the expectations of our people — that they should have access to a range of post-secondary educational opportunities, regardless of where they live — has shaped our post-secondary system.

We have three universities, two in the Vancouver area and one here in Victoria. Each of these has a mandate to serve the whole Province. While most of their emphasis is upon relatively traditional campus-based programs, many university courses have been offered using both correspondence and the interactive TV network we have established using a communications satellite — but more of this later.

In addition to the universities we have 15 regional colleges and five provincial institutes. The mission of the college and institute system of the Province of British Columbia is, and I quote from our policy statement:

> "To provide educational opportunities to assist adults to meet continuing and changing individual, economic and societal needs. These opportunities will be provided recognizing the aspirations of individuals, the present and future requirements of Provincial and Canadian society for economic development, the priorities of Government and the structure of the education system . . ."

It goes on to provide more detail on some seven goals. Those of particular relevance to this topic are:

Accessibility

The system will strive to increase access and equity of access to post-secondary education opportunities for all British Columbians.

Comprehensiveness

The system will be comprehensive by providing diverse program-orientated learning experiences to meet individual needs for personal development and societal needs for an educated and well-trained population.

Efficient Use of Resources

Consistent with emphasis on quality, the system will endeavor to operate in a manner which makes efficient use of all resources provided.

So given our physical geography, our changing economic base, and the expectations and aspirations of our people, we are in the process of developing flexible, innovative and economic ways of providing educational opportunities.

We are also concerned that our people have the chance to acquire the skills that will equip them to compete in tomorrow's world, one where we are told there will be increased use of "technology."

However, we need to distinguish between expensive technical gadgets that contribute little to the educational process, and those devices that are absolutely essential and must be part of our educational system.

We have had difficulty in selecting the appropriate systems from the bewildering array of choices, where each one requires a significant investment of funds and is incompatible with what is on the "drawing board" for the future. The high rate of technical change, and the decreasing costs have also contributed their share of confusion, making it easy to postpone making a decision.

Thus as Government, with the responsiblity to provide leadership and direction, we have been faced with the same difficulties many of you have expressed. We could not wait for the technical market to sort itself out. So we have decided to tackle the problem in a pluralistic fashion, encouraging many small-scale local experiments, and establishing a few Provincial demonstration projects. Using the experience we gain through these endeavours, we hope to identify the issues that need Governmental attention.

There are many such examples, but I will mention only a couple of those projects where the technology is a means of delivering instruction, and not an integral part of the training. North Island College was established to test and develop non-traditional instructional delivery methods across the whole range of college offerings. While most of their courses are in print-based modules — similar to correspondence — some locally-developed computer-assisted courses are offered using a network of micro-computers.

Camosun College, here in Victoria, is conducting a test using the PLATO system that was developed for a mainframe computer and offers something in the order of 8,000 course topics.

As. Dr. Glen Farrell described to you yesterday, the Knowledge Network was established to provide the education system with access to broadcast television via a communications satellite. By using this network, in conjunction with local colleges and the Open Learning Institute, credit and non-credit courses have been made available in all regions of the Province. While using a scrambled satellite channel we can, for instance, link a hospital operating theatre with the UBC Medical School and/or the College centres to provide professional development for the medical profession.

We have established a demonstration project in the provision of training in electronics, where students are directed by a micro-computer through a number of theory exercises, some physical experiments, and video material resulting in a richer and more interesting learning environment, yet one that permits the students to progress at their own rate and at their convenience.

We have encouraged and supported institutions in the development of computer-based administrative systems and have experimented with systems for both the central mini-computers and local micro applications. For instance, the Colleges of New Caledonia and Cariboo have acquired commercially-developed software for Computer Managed Learning (CML), to track students' progress and manage test banks on their mini-

computer. In addition, an instructor in Selkirk College has developed his own system for his own program area on a little Rainbow micro-computer.

As we attempt to distill policy out of an incredibly rich array of possibilities, we are committed, firstly to ensure that the use of technology in our vocational, technical and career programs at least reflects the current level of sophistication in industry. Secondly, we intend to ensure that our institutions have the capacity to remain current. Our goal is that our programs should strive to teach skills required by the industrial leaders or innovators in any particular field of employment.

With the increased use of Computer Assisted Instruction (CAI), and the associated costs of developing suitable software, we want to ensure that our faculty have the incentive to develop material, and ensure that the provincial educational system has access to their work. Thus the issue of copyright and ownership is one that requires attention.

I feel the Province should retain copyrights of anything developed with provincial funds, whether the funds came from institutions' operating budgets or from some special project fund. Yet I can agree that the chance to market one's work can be a powerful motivator to put in that extra effort to develop a really high-quality product.

I would appreciate your advice as to how you have addressed this issue in your jurisdictions.

We have struggled with the issue of standardization of hardware to ensure compatibility of software developed across the Province.

Whenever I raise this issue with my officials I am reminded that in February 1972 the Ministry established a committee to select a standard for video tape recorders in the Province. By April the report was published and policy established that the ½" reel-to-reel was the provincial standard. In May — about three weeks later — the ¾" cassette player was introduced and within about six months all the reel-to-reel machines had disappeared . . .

Therefore, during this period of rapid change and development, we have permitted each institution to adopt the system that most suits their needs and fits their budgets. We are now at a stage where we have some better understanding of the technology, and if we, as a province, are going to make a major commitment to computer-assisted instruction we need to ensure that the operating system for any development is compatible with those available in our institutions. So once again we are confronted with the question of establishing provincial standards for provincial curriculum projects, and we must recognize that any work will have a very limited shelf life.

Perhaps the major issue facing us is how to keep our faculty's skills current, and how to retrain them, to enable them to take advantage of the current and future technology. This is difficult even when the technology is an integral part of their field. Nevertheless, this is an issue that must be addressed if we are to maintain the quality of training and education available in the Province.

We do not think we have any option but to make use of these devices where their adoption can contribute to our goals. We have, therefore, established a joint Ministry institution committee to review and advise upon any "instructional use of computer" proposals we receive.

The first task of this committee was to develop a discussion paper that identifies the issues we need to address. While this paper will be completed within the next couple of months, I have tried to second-guess the committee in posing the questions I have just raised.

As I said earlier, we have adopted a pluralistic approach to the adoption of technology. Issues concerning the development and use of technology are being considered carefully prior to making major policy decisions that affect our provincial post-secondary system. We don't want to stifle innovation by a heavily-centralized bureaucracy, yet we need to manage and co-ordinate this revolution to ensure that we do not waste time, money or (more importantly) the enthusiasm and energy of the people in our system.

ALBERTA

Daniel E. Berghofer, Assistant Deputy Minister, Department of Advanced Education

Introduction

In addressing the issue of Government policy for the use of educational technology, it is important to realize that there is, strictly speaking, no such thing as educational technology. Essentially, what we are talking about is making use of a wide variety of communications technologies for educational purposes.

This is an important distinction to make because if you begin from this standpoint, then you keep the focus on the purpose and objectives of education, rather than on the multitude of different things that technology can do. After all, no matter how spectacular technology might be, if it doesn't help more people learn more effectively and efficiently then it really isn't of much interest to educational policy-makers.

So, you have to start with the educational issues rather than the technological issues. That is the first point I wanted to make.

Having said that, however, I must assert that education does not have any choice as to whether it will embrace the use of technology. The reason is that industrialized society is moving rapidly towards what some people call post-industrialization or the communications era or the knowledge society.

Whatever you choose to call it, the important thing to understand is that the technology we are working with in this new age is quite different from the technology of the industrial age. The technology of the industrial age was concerned with extending the muscle-power of human beings. The new technology is concerned with extending the brain-power of human beings. The symbol of the industrial age was the steam engine housed in what was then a new form of organization called a factory. The symbol of the new age is the computer and it is not going to be restricted to any specific physical location because it is going to become part and parcel of the way human beings think and go about their business, no matter what their business might be — whether it be farming or fishing or engineering or poetry writing or painting or providing medical care. If anyone had any doubts about the pervasiveness of this new technology, they should certainly have been dispelled in listening to the presentations this morning from Britain and the States of Michigan and New York in the United States.

The point here is that modern communications technologies, and particularly the computer, are the kinds of technologies with which human beings are beginning to interact to manipulate and disseminate information and to create knowledge. We use them to talk to each other, to sort information, to design products, to help us in making decisions.

Now those kinds of activities, of course, are educational activities. So it is unthinkable for policy-makers in education to say we will not use communications technology. The very environment in which we live demands that we use them and that is equally true for the developing world as it is for the developed world. In fact, it's these very technologies that are bringing the so-called first, second, third, fourth, and fifth worlds so close together that we can't afford to ignore each other.

That is why a conference like this is so timely and the Government of British Columbia is to be congratulated for hosting it. You might also be interested to know that just last week the Government of Alberta in co-operation with the Commonwealth Secretariat sponsored a conference in Edmonton to discuss the use of micro-computers in schools in Commonwealth countries and to prepare some policy guidelines for future development. I believe this kind of sharing of expertise and experience is most important because more and more we must find solutions together.

The nub of the policy question is to know what kind of intervention to make, and I think that the decision depends very much on the context in which you find yourself. If you are a small jurisdiction with a large

population, your context is different from that of a large jurisdiction with a small population. If you have relatively flat terrain so that you can easily microwave signals from one transmitter to the next, your context is different from one where you are trying to get communications across mountains 3 000 metres high. If you have a well-established telephone system laid with copper cables, your situation is different from one where there is hardly any system at all, and it's different again from one where there is a fibre optics system in place.

But whatever the context, the question with which you start is the educational question, not the technology question. The first question is what are the educational problems to be solved. The second question is what technologies are available to help solve those problems. The third question is what steps need to be taken in order to ensure that when you introduce that technology into an already established system, it will be accepted and used.

You know, in Canada, and probably in North America generally, we tend to be seduced by technology. We have a tendency to invent technology and then try to figure out what to do with it. And then we have all those super salespeople out there whose livelihood depends on their ability to convince us that the new technology is good for us. If we don't put enough effort into debating the educational questions first, we can easily find that we have a lot of expensive hardware sitting around not being used. And I think I detected in a couple of the presentations yesterday that if people had the chance to do things over again they might spend more time asking the question about how they are going to use the technology before going ahead and buying it.

The Alberta Context

From the background which I have just outlined I would now like to report on some of the initiatives which we have taken in the post-secondary system in Alberta.

When I talk about the post-secondary system I am referring to a somewhat loosely co-ordinated arrangement of four universities, eleven community colleges, three technical institutes, four vocational centres, a few special purpose institutions, and a number of private colleges. In addition, we have a unique (at least to Canada) policy on non-credit education for adults based on the establishment of 85 further education councils distributed throughout the Province.

I say that this system is rather loosely co-ordinated because the several components vary tremendously in size, complexity and function. Two common elements are that they all have a large degree of autonomy and they all provide educational services to adults usually over the age of 18.

The Department of Advanced Education provides the bulk of the funding for the system and tries to ensure that it works reasonably well in responding to educational needs with the minimum of duplication and confusion.

With respect to the development of technology, our approach at the policy level has been **implicit** rather than **explicit.** In other words, we have not sought to develop and implement a grand plan for the use of technology in education, but rather to encourage and support specific initiatives which, if successful, can then be implemented across the system.

Perhaps our most notable success in this regard has been in the area of computer-managed learning. More than ten years ago we supported an innovative project in the electronics department at the Southern Alberta Institute of Technology in Calgary. This resulted in the development of a software package to manage the educational program of students in electronics technology. What this means is that the students signed on to the program through the computer which then tested their level of knowledge and on the basis of the result directed them to further study. The further study may have been from an instructor or from a text book or from some audio-visual sources. After further study the student then returns to the computer for testing and instructions on what to do next.

Following this successful pilot project in one small department of one institution we have since refined and used that technology to manage the learning of students all across the Province in such areas as emergency medical technology, power engineering, adult basic education and nursing education. We haven't particularly advertised the package, but it has become known outside Alberta and is now in use in various ways in the states of Victoria and Queensland in Australia and in the Provinces of British Columbia and Saskatchewan in Canada.

Through this same implicit policy approach we have supported the development of another promising technology — the video-disc. We believe this has the potential for being effective in the independent learning of skills and for subject matter with a high visual content such as anatomy and art.

In the area of computer-assisted instruction we have not put a lot of effort into the development of courseware. However, the University of Alberta has a history of involvement in that field dating back to 1969. More recently the university bought into the PLATO system which now has approximately 2,000 hours of lessons in a wide range of disciplines. Our contribution from the Department of Advanced Education has been to enter a joint project with the university to fund the development of an authoring computer language which makes it possible for instructors without any knowledge of computer programming to develop courseware in their area of expertise much more rapidly than was possible before — at least ten times more rapidly. This authoring system, known as OMNISIM, also has attracted interest outside Alberta and is now being used in British Columbia, California and Italy. Conversion to French takes place this summer.

In another area of technology we are beginning to make very effective use of an "old" communications device — the telephone. We are fortunate in Alberta to be at the forefront in world development in digital switching and most parts of the Province are served by an excellent telephone system. Moreover, the Government of Alberta created a telephone network to allow toll-free communication with and among Government. The network operates 24 hours a day but gets very little use after 4:30 p.m. What we are now doing is using that system after hours to provide courses by teleconference to any part of the Province without the cost of line charges. Through another innovative project we are developing the use of telewriting on this system so that visual as well as auditory instruction can be given.

Closely related to the subject of communications technology in education is the concept of distance education. At the forefront of work in this area in Alberta is Athabasca University, the only university in Canada specifically established as an open-learning, distance education institution. To date the primary method for Athabasca University to deliver its courses is through print-based materials. However, a recent decision by the university to establish a Research and Development Centre for the delivery of education promises to bring a greater focus on the use of electronic modes of delivery.

I could cite many more examples of how technology in post-secondary education is being supported in Alberta. More important than that, however, is to repeat the principles on which our policy of support is based:

(1) First, it is needs-driven, that is, a specific educational problem in need of a technological solution has been identified.

(2) Second, there has to be grass-roots interest in solving the problem.

(3) Third, the technological solution has to have the potential for widespread application and if possible it should be a joint venture of several institutions.

(4) Fourth, there has to be commitment *a priori*, before the fact, by senior administrators that they will sustain the initiative if it proves to be successful.

Conclusion

In closing I would like to mention some other policy initiatives which are beginning to pay off for the use of technology in post-secondary education in Alberta.

One was the decision about ten years ago to establish the Alberta Educational Communications Corporation, commonly known as ACCESS. This corporation has had mixed success over the years, mainly because it was overly pre-occupied with television production. Now it is beginning to understand that it is in the communications business rather than the television business, and it has provided to the educational system a full 24-hour a day use of a transponder on the Anik C satellite. This was done without a single dollar of increase in the operational budget of the corporation.

The second policy initiative was not exclusively directed at technology, but it has had a dramatic impact in that area. In 1980 the Department of Advanced Education created an Endowment Fund for the Eighties. Originally, it was to provide $8 million a year for ten years of matching funds for donations from the private

sector. The computer industry was so sharp in getting in on this action that it alone used up more than $40 million of the fund in two years. The result is that we have just announced another $80 million for the rest of the decade with some restrictions to be placed on matching donations from the computer industry.

In another initiative involving collaboration between the public and private sectors the Government of Canada was instrumental in creating in Calgary in 1985 what promises to become one of the leading centres for research and development for technology in education in the country. This is the Canadian Centre for Learning Systems which was established with a $800,000 grant by the Canadian Federal Government and is being sustained by an operating budget of more than $500,000 a year contributed by a consortium in Calgary. On the public side the participants include not only post-secondary institutions, but also both school boards in the City of Calgary.

In the area of economic policy in Alberta we are very conscious of the interface between education, communications technology and economic growth. The resource base of our Province is currently very heavily dependent on oil and gas and agriculture. Given the world-wide disruptions that are occurring in those sectors, our Government has a major concern in diversifying the economy. Having a small, land-locked population makes that a particularly challenging opportunity and we see telecommunications as a key strategy. Toward that end the Government recently established a separate Department of Technology, Research and Telecommunications, and we have already funded a number of specific research and development initiatives in microelectronics and chip fabrication and a major proposal for software development is under consideration.

To sum up what I have meant to say in this presentation is that all of us are moving very rapidly into a world in which the overwhelming driving force will be communications technology. It will have tremendous implications for how human beings spend their lives. Each succeeding generation will be spending more and more time pursuing education as we enter the age of lifelong learning. Educational systems will be challenged to embrace the use of more and more powerful communications technologies, but they should never do it for the sake of the technology; only for the sake of meeting some clearly identified educational purpose.

If we proceed in this way we will probably be doing as well as we can reasonably expect to do in the development of Government policy in the use of technology in education.

DISCUSSION

THAILAND

How does Alberta make use of telephones?

ALBERTA

We actually teach using conference calls, with the instructor in one place, perhaps with some students, and other students in groups or alone at the end of the telephone wire. *But*, we have a big advantage in that Alberta has a Government phone system, so rates are low.

HAWAII

How do you convince politicians that not all education has to be delivered through high technology, that basics are important too?

ALBERTA

There is a lot of pressure. We simply have to resist.

GHANA

How do you provide skills training?

ALBERTA

We have not done a great deal, but we have done some training of nurses with video-discs. We have also done work with deaf-signing and electronic repair work. As long as we have specific skills, to teach, video-discs work well.

CHINA

Shi-qin Yang, President Harbin Institute of Technology

Education is a social enterprise and through it we can foster the kind of personnel society requires. The university in particular makes a direct contribution to the advances and economic development of science and technology. The special feature of industrial universities in China is in the close union sought between education and construction of the economy.

Since the Chinese Revolution, educational reform was carried out in the universities in order to meet the demand for specialists who would quickly develop the weak economy. The educational system of old China was altered to provide specialized education which enabled success of the First and Second Five Year Plans. The Harbin Institute of Technology served as an experimental model during this period, in which education and production were tied closely to each other. The circumstances then were as follows:

First, the institution of engineering subjects was integrated with the needs for state industry-building. Second, factories outside the schools became incorporated as part of the school facilities. Actual production was carried out within classes and a high proficiency in foreign languages was seen. These satisfied the pressing needs of the state economy at the time. Personnel educated in this way now serve as the core of the scientific and technical circles of present-day China.

During the early 60s, China established an elementary industrial system. After entering a period of high growth in the economy, a stage was reached in which education in industrial universities linked up with production. Some of these features were as follows:

First, industrial production moved from imitation and import-oriented to individual planning and development-oriented. The schools took part in production and entered into a new relationship of co-operation with the factories.

Second, scientific research aimed at vanguard sciences became the major obligation of the schools. Thirdly, classes began to take up scientific research as well as production and development, the results of the former being applied to the latter.

On the other hand, the amount of labor was excessive at times while basic theory was neglected. Through the Cultural Revolution knowledge was denied furthermore, and an opportunity for making great technical advances was lost.

University education today faces the challenge of a worldwide technological revolution. With the "four-point modernization" as its goal, China sees education as an important strategy for building its national economy. Its educational policy is to contribute to the materialization of a modern socialism linking together theory and practice for the future.

It seeks to establish the universities as a relatively independent educational entity and to construct a new system in which education, scientific research and production form a tripartite arrangement. The great changes which have taken place recently are as follows:

First, a multi-layered higher education system was established materializing programs for bachelor's, master's and doctorate degrees. HIT has been educating graduate students since 1950. There was an instance in which a master's thesis was adopted by the National Planning Committee as significant scientific research.

Second, education and scientific research were tied together further to institute specialized research facilities and to develop an organization of researchers. Research was developed broadly in the areas of basic theory and applied sciences, and it became possible to transform the results as productivity, thereby returning the economic results to society. HIT emphasizes research in the applied sciences. It has been recognized by the state for its work on the burning of coal, an important strategic resource for economic construction. Basic research is also showing considerable development.

Third, joint development of education, scientific research and production based upon co-operation between the factory and the school can be seen. Scientific technology is an important key for economic development; however, technology is still lacking in the businesses. Since the universities hold educated personnel, they have a twofold responsibility to provide research results and personnel. HIT has co-operative relationships with over 200 businesses all over the country.

These joint groups can be classified into three: technology-intensive groups to face the challenge of a Fourth Industrial Revolution; development-centred groups to create new technologies and products; production-centred groups to manufacture and sell new products.

These joint groups have developed according to the principle of spontaneity, equality, mutual benefit, sincerity, and co-operation. The merits of universities are being fully utilized and school education and social progress are becoming more integrated.

Following this policy, China will attempt to meet the needs of increased economic growth, aiming at the Four Modernizations based upon the development of university education projects and science and technology.

Symposium Summary

James J. Hewitt, Minister of Education, British Columbia

It is my task to attempt to summarize the proceedings of the past two days. Typically, people in my position call attention to the most common factors that have arisen, and I will do my best to follow that tradition.

Before I do so, however, I would like to draw attention to the disparities we have here. We have disparities of size — delegates come from jurisdictions ranging from Iceland, with 200,000 people, to China, with 1 027.5 million. Physical size ranges from Singapore, with 600 square kilometres, to Canada, with 9 976 000 square kilometres.

Resources range from New York, which spends hundreds of millions on high technology, to some of the developing nations that don't have pencils and paper for all their students.

But for all these differences, there are some things that we have in common.

We are all agreed that education comes first, and technology second. In other words, we have to know what we want to teach our students, and then examine the possible delivery systems. If it turns out that high technology is an appropriate delivery system, we must then examine the cost effectiveness of possible technologies. Only if we are sure that modern technology will do the job, and that it will be cost effective, should we make large investments. Textbooks and blackboards may not be exciting, but they work.

Finally, I have heard common agreement that we depend on our teachers to accomplish educational goals. No matter how involved in modern technology we may be, if the teachers are not whole-heartedly behind the effort, it will not work. Teachers interacting with students, whether face to face, over television or telephone line, or through micro-computers, are what education is all about, and it doesn't seem likely that will change in the near future.

We keep talking about how we depend on our young people to lead the way in the future, and that is true more than ever before. The world is changing so quickly that people of our age are not able to keep up with the changes. We really do depend on our young people. By the same token, they depend on us to provide them with the wisdom that they will need as they work with all the technological miracles that are here now, and the others that are just around the corner.

I hope this symposium has helped all of you as much as it has helped me in understanding the issues that face us as policy-makers in this area. I am glad to have met you, and I trust we can spend more time together at the World Congress in Vancouver.